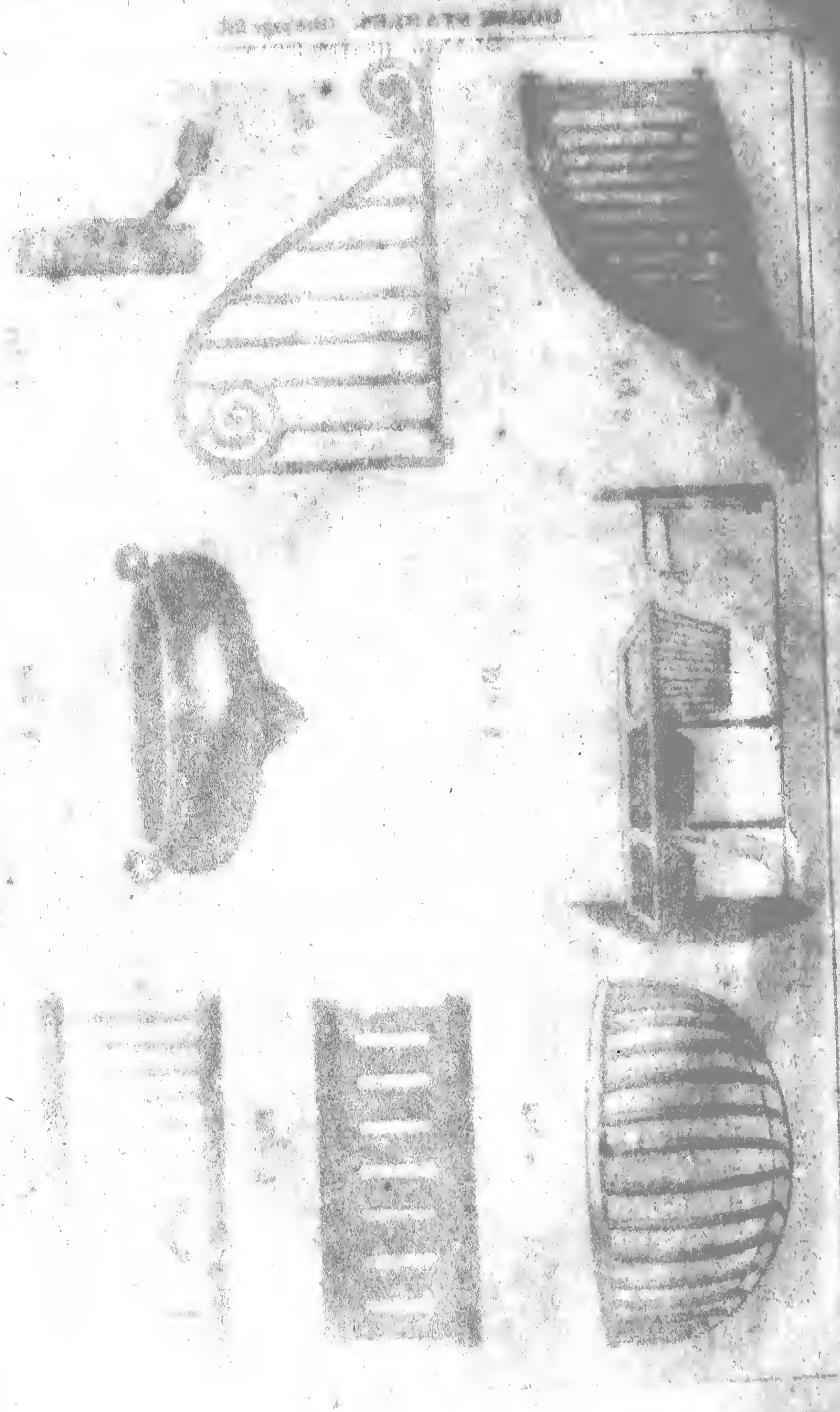
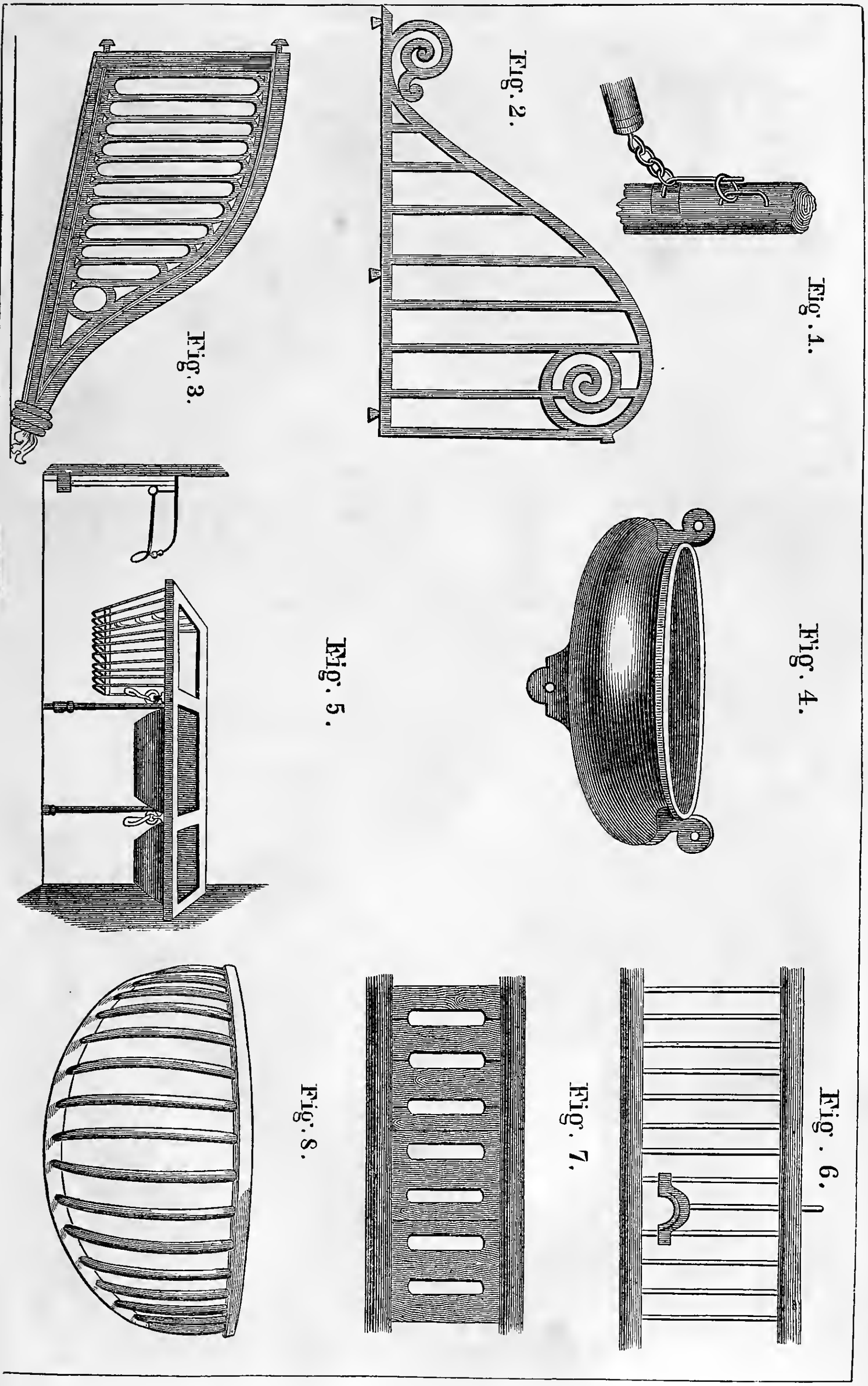
ELAND. (See page 212.)



HORSE STABLES. (See page 260.)



36th Congress, 1st Session. } HOUSE OF REPRESENTATIVES. { Ex. Doc.

REPORT

OF THE

COMMISSIONER OF PATENTS

FOR THE YEAR 1859.

AGRICULTURE.

WASHINGTON:
GEORGE W. BOWMAN, PRINTER.
1860.

IN THE HOUSE OF REPRESENTATIVES, *June* 13, 1860.

Resolved, That there be printed, in addition to the usual number, three hundred thousand extra copies of the Report of the Commissioner of Patents on Agriculture, for the year 1859; fifteen thousand of which shall be for distribution by the Interior Department, and two hundred and eighty-five thousand for the use of the House of Representatives.

REPORT

OF THE

COMMISSIONER OF PATENTS.

UNITED STATES PATENT OFFICE,
January 3, 1860.

SIR: Agreeably to the design of Congress, as indicated in the clause of the act of March 3, 1859, "for collection of agricultural statistics, investigations for promoting agriculture and rural economy, and the procurement of cuttings and seeds," I have the honor herewith to transmit the agricultural portion of my report.

Owing to the reduced appropriation made by Congress for agricultural purposes, for the fiscal year ending June 30, 1860, the office has been compelled to reduce its expenses and confine its action to a more limited sphere than heretofore. In doing this, it was found necessary either to decline purchasing for distribution the usual varieties of garden and field seeds, or to abandon the experiment of propagating the tea, and various other foreign plants and grape-cuttings, for which orders had been given. The expense which had already been incurred in their procurement would hardly justify the office in throwing them aside. It was accordingly deemed advisable to apply the remainder of the funds solely to the procuring of information and preparing the material for the Agricultural Report, and to the propagation and distribution of such varieties of foreign seeds and cuttings as had been already engaged. These were of such a nature that, if they had been distributed throughout the country immediately upon their receipt, the probability is that very few of them would have reached their destination in a fit state for propagation. The tea seeds, more particularly, arrived in such a condition that it was of the utmost importance to plant them at once. For this purpose, large propagating houses were erected upon the government grounds north of the canal, between Four-and-a-half and Sixth streets. These structures now answer well the purpose for which they were intended, as is exhibited by the fact that we have, ready for distribution, over 30,000 well-rooted tea plants,

12,000 foreign and domestic grape-vines 900 rooted, seedless, pomegranate cuttings, and various foreign, medicinal, and ornamental plants. These will be ready for distribution during the present winter and the ensuing spring.

The nature of the tea plant is such that it cannot be successfully cultivated in the open air above the northern boundaries of Tennessee and North Carolina. For this reason, the larger portion will be sent south of that line. A sufficient number, however, will be divided among the remaining States, to satisfy the reasonable demands of such persons as have the conveniences necessary for their protection during the winter months.

Last summer and fall an agent was employed to travel through several of the Northern States for the purpose of collecting the best varieties of ripe native grapes. An experienced chemist was also engaged to analyze the fruit thus collected, for the purpose of ascertaining the amount of saccharine matter and other ingredients contained in the juice of each variety, and determining which kinds are best adapted to the making of wine. The reports of the agent and chemist appear in this volume, and will, no doubt, prove valuable and interesting to the public.

It is now about twelve years since Congress adopted the system of making annual appropriations for agricultural purposes. Previous to this time, there seemed to be but little progress made by the people in this branch of our national industry. Agricultural newspapers were then in their infancy, while agricultural societies were scarcely known or heard of. The attention paid by Congress to this subject seems to have awakened the people to its importance. It has stimulated inquiry, encouraged new experiments, and to such an extent has the public mind been excited, that agricultural societies have been formed and are now in successful operation in nearly every county and State throughout the Union. Newspapers entirely devoted to agriculture are published in nearly every State, and at prices which place them within the reach of all. Enterprising men in all the principal cities have established agricultural warehouses, where varieties of seeds, plants, and cuttings, from foreign lands, as well as from different sections of our own country, can be purchased upon reasonable terms.

More recently, a national agricultural society has been established, which will undoubtedly prove valuable as a medium of communication between the various county and State societies. Indeed, so thoroughly have the public become impressed with the importance and necessity of paying more strict attention to improvements in agriculture, that

it may well be doubted whether anything Congress may do can give an additional impetus to the movement.

I have no hesitation in saying that the necessity no longer exists of distributing the various seeds of *domestic* growth, inasmuch as the facilities for obtaining them are such that every person of enterprise enough to cultivate them can obtain everything in that line from the seed-stores. If, therefore, it is the desire of Congress to continue the appropriation for agricultural purposes, I would recommend that it be limited solely to the collection of valuable information for the agricultural report and the collection and distribution of such varieties of foreign seeds, plants, and cuttings, as have not heretofore been introduced into this country.

All of which is respectfully submitted.

WM. D. BISHOP,
Commissioner.

Hon. WM. PENNINGTON,
Speaker of the House of Representatives.

INDEX.

GOVERNMENT EXPERIMENTAL AND PROPAGATING GARDEN.

Prominent among the purposes of the government, with respect to agriculture, is the introduction of trees, shrubs, and plants from other countries. In whatever form these are received, whether as seeds, roots, cuttings, or plants, the most tender treatment is generally requisite to preserve, develop, multiply, and acclimatize them; and every possible facility therefor should always be in readiness at the moment of their arrival.

The want of accommodations of this character had long been felt, when, in August, 1858, intelligence of the transmission of a quantity of tea seeds, from China, created an immediate necessity for their provision. A plot of five acres was accordingly chosen, in a central position, in the city of Washington, and prepared in the manner described in the Report of the Commissioner of Patents on Agriculture, for that year. A system of underground tile-drainage, upon a plan now common in the United States and in Europe, was applied to this ground, and with excellent results for a time; but, unfortunately, there was a want of adaptation in the manner of laying the tiles upon the yielding, marshy base, and the continuity has consequently been interrupted by occasional depressions. When this shall have been remedied, as it doubtless may be without serious detriment to the field or its products, the experiment may be regarded as complete and satisfactory.

The plan pursued in constructing and warming the green-houses upon this ground, though successful in its present application, is not commended for all purposes. Decomposing vegetable matter, covered with a portion of nitrogenous materials, might be adapted to general use, were the process of decomposition susceptible of being controlled at will: but so variable is its progress, and so dependent upon external influences, in a ratio inverse to the requirements within, that the vicissitudes of temperature proceeding from it are such as none but hardy plants can endure. The volatile emanations are likewise in excess in this process, insomuch that even those plants which become accustomed to and prove capable of sustaining an atmosphere so highly stimulating may suffer when suddenly withdrawn from its influence and exposed to the open air.

The partial exclusion of the light and warmth of the sun, practised in connection with this plan, also proves detrimental to tender plants, while the altitude of the roof, eleven feet at the apex, is to them a constant and certain cause of slender and feeble growth.

Happily, these disadvantages are remediable at small cost of money and labor, by the provision of apparatus for artificial heating, the elevation of the beds, the adoption of means of ventilation, and the extension of the glass roofing over the whole of each structure.

The garden thus established may be properly applied to other uses than the propagation of exotic plants. Not only may the tea shrub, the cinchona tree, the camphor tree, the cork tree, and others of foreign origin, be nurtured here, but also many native as well as foreign plants desirable for their edible and medicinal properties and products and ornamental qualities. The amateur, pharmaceutical, and professional botanist may here examine the vegetation of many soils and climates, and witness experiments in the culture and hybridization of various trees and plants. Among those now in course of cultivation the following may be named:

Tea shrub from China, 32,000 *plants:* The proposition to introduce the tea shrub of China to culture in the United States has been discussed in the Reports of the Commissioner of Patents, for the years 1855 and 1857; and information, gleaned from accredited sources, has been given in regard to this plant, and the soils, climates, and conditions of its profitable growth and preparation. The subject is now presented in a practical form; a new interest has been excited in regard to it; and information, upon which the American planter may rely, is demanded by the exigency that has arisen.

Tea was little known in Europe until the middle of the seventeenth century. Mr. Pepys, secretary of the British admiralty, in 1661, speaks of "tea, (a China drink,) of which," he says, "I had never drank before." Three years later, the Dutch East India Company presented two pounds and two ounces to the king of England, as a rare and valuable offering; and, in 1667, this company, by the importation of one hundred pounds, commenced a traffic that has grown to the magnitude of thirty million pounds, for home consumption alone, in England, yielding a revenue to the government of about £4,000,000 per annum. The value of the tea imported into the United States, in the year ending June 30, 1858, was $7,261,815, and, in the succeeding year, $7,388,741.

The use of tea as a beverage was, for a time, strenuously resisted in Europe, on the ground of its alleged deleterious influence on the human constitution. Many diseases were declared to be aggravated, if not superinduced, by it, and manifold evils were predicted from the importation. This should not be a subject of surprise; since, like many other luxuries, and especially vegetable narcotics, tea is repulsive to the natural appetite, and its effects, when used in excess, are very powerful, and, it may be, hurtful to an organization not habituated to its use. But it is now generally conceded throughout the civilized world, not only that tea is far less pernicious and offensive than any of the various excitants or stimulants it has displaced, but that it has proved a positive benefit to the world, with as few evidences of injury from its abuse as exist in relation to any article of luxury, or of food, with which we are acquainted. The chemical principle characteristic of tea, coffee, and cocoa, has been found one and the same, and has been called, indifferently, theine and caffeine. Dr. Ure remarks that the proportion of azote in theine or caffeine is much greater than even in any animal compound, urea and uric acid excepted, and adds: "Since so many different nations have been, as it were, instinctively led to the extensive use of tea, coffee, and chocolate, as articles of food

and enlivening beverage, which agree in no feature or property but in the possession of one peculiar chemical principle, we must conclude that the constitution of these vegetable products is no random freak of nature, but that it has been ordained by Divine wisdom, for performing beneficial effects on the human race."

Various writers have made conjectures with respect to the time and manner of the discovery, by the Chinese themselves, of the properties and uses of tea; but, as with most questions respecting the social history of China, all is vague and unsatisfactory. A passage has been quoted from an ancient work, entitled, "Periplous of the Erythræum Sea," (the Red sea, or Arabian gulf,) which Vossius Vincent and other writers have regarded as relating to the betel nut; but which Rhind, in his "Vegetable Kingdom," recites as descriptive of the tea plant and its cultivators eighteen centuries ago: "There used to come, yearly, to the frontier of the Sinæ, [a people inhabiting the southeasternmost part of Asia, supposed to be the same as the Cochin-Chinese,] a certain people called Sesatæ, with a short body, broad forehead, flat noses, and of a wild aspect. They came with their wives and children, bearing large mats full of leaves, resembling those of the vine. When they have arrived on the frontier of the country of the Sinæ, they stop and spend a few days in festivity, using the mats for lying upon; they then return to the abode of their countrymen in the interior. The Sinæ next repair to the place, and take up the articles which they left; and having drawn out the stalks and fibres, they nicely double the leaves, make them into a circular shape, and thrust into them the fibres of the seeds. Thus three kinds of *malabathrum* are formed; that from the larger leaf is called *hadrosphœrum;* that from the middling one, *mesosphœrum;* and from the smaller, *microsphœrum.*" The fact that any reliance has been placed upon this statement, for the purpose of proving that tea was known to the Greeks or Romans in the first century, but serves to show how destitute the civilized world was of all knowledge of it prior to the era of its introduction, in the seventeenth century.

However remarkable it may be that a product, destined to become essential to the people of every nation, and to constitute an important commodity in the commerce of the world, should so long remain hidden from our knowledge, it is still more anomalous that, for two centuries after its general adoption, the culture of it should still be limited, with comparatively inconsiderable exceptions, to the regions in which it is indigenous, viz: to China, Tonquin, Japan, and Assam, in India, in which last-named country, though the plant always existed abundantly in a wild state at the base of the Himalayan mountains, its cultivation and the manufacture of its product, and the introduction of plants from China, have been but recently commenced. The first stimulus to this enterprise was given by Dr. Royle, who, in 1807, directed attention to the subject, and induced the formation of the Assam Tea Company, which now exports large quantities of tea of superior quality, chiefly, it is represented, from the indigenous plant (*Thea assamica,*) which is regarded there as a distinct species. The cultivation of tea is also prosecuted with success in Penang, more than a third of the

population of which is composed of Chinese; and in Java, where, in a population of nearly 10,000,000, there are more than 100,000 Chinese. From Java, the exports of tea were valued, in 1848, at $336,206. The plant was introduced to both these islands from China, the experiment in Java, initiated by the Dutch proprietors, having precedence of all other attempts of the kind.

On this continent, Brazil has gone before us in the adoption of the Chinese plant. Here, although comparatively little effort is required for the subsistence of man; although an indigenous plant, the maté, (*Ilex Paraguayensis*,) is in general use among the people; although coffee, long a staple product of the country, is of equally general consumption; and although an inveterate prejudice exists in favor of the manufactured tea of importation, yet the culture continues to increase and to gain favor among the people, insomuch that it may be regarded as an established branch of industry. In a letter from Mr. John Rudge, of St. Paul, Brazil, who has been for many years engaged in the cultivation of tea in that province—communicated to the Patent Office in April, 1859, by the United States legation at Rio de Janeiro—the writer says: "The tea plant flourishes here, I think, equally as well as in its native country, and I can see no reason why it should not do as well in the southern regions of the United States. The valleys are best suited to it, and it delights in manure. Care should be taken not to cover the seeds too deep in planting; they should be merely hidden from the sun.* The tea is made from the newest and softest leaves. I usually cut the tree down every year nearly to the ground, that it may produce leaves and not seeds. When it is permitted to go to seed, the leaves become hard and unfit for use as tea. The plant is a very hardy evergreen, never suffering in the slightest degree from the frosts, which greatly injure our coffee and cane in the low grounds. The home consumption is much affected by the partiality of the common people for coffee, and the prejudice of the higher classes in favor of tea brought from afar. In some instances, tea grown in this region having been sent to Rio, and there put up in Chinese boxes, and having a small proportion of Chinese tea mixed with it, has been returned to St. Paul and sold for double the price the producer would have demanded for it. But such conceits, I believe, are common to those who can afford to indulge them throughout the world."

In the historical and descriptive sketches of "Brazil and the Brazilians," by Rev. D. P. Kidder, D. D., and Rev. J. C. Fletcher, whose experience in that empire extended through a period of twenty years, published in 1857, an account is given of the adoption, progress, and prospects of tea culture, which merits the perusal of every American reader. These writers say:

"There is probably no other country where the culture of this Asiatic shrub has been so successful away from its native region. The Portuguese language is the only European tongue which has preserved the Chinese name (cha) for tea; and as the stranger at Rio de Janeiro and other towns of the empire passes the vendas, he is always sure to

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*The protection of two or three inches of soil will be found requisite in the United States.

see a printed card suspended, announcing Cha da India and Cha Naçional; the former is the designation given to tea from China, and the latter to the same production grown in Brazil.

"In 1810, the first plants of this exotic were introduced at Rio de Janeiro, and its cultivation, for a time, was chiefly confined to the botanical garden, near the capital, and to the royal farm, at Santa Cruz. In order to secure the best possible treatment for the tea, which it was anticipated would soon flourish so as to supply the European market, the Count of Linhares, prime minister of Portugal, procured the immigration of several hundred colonists, not from the mingled population of the coast of China, but from the interior of the celestial empire—persons acquainted with the whole process of training the tea plant and of preparing tea.

"This was probably the first colony from Asia that ever settled in the New World, of which we have authentic records. The colonists, however, were not contented with their expatriation; they did not prosper, and they have now disappeared. Owing, in part, doubtless, to characteristic differences in the soil of Brazil from that of China, and perhaps as much to imperfect means of preparing the leaf when grown, the Chinese themselves did not succeed in producing the most approved specimens of tea. The enthusiasm of anticipation, being unsustained by experiment, soon died away; and near the city of Rio de Janeiro, the cultivation of tea has dwindled down to be little more than an exotic grown on a large scale at the botanical gardens.

"As a government matter, it was a failure; but several Paulista planters took up the culture, and, though they encountered years of discouragement, they have lived to see it, though as yet in its infancy, one of the most flourishing and remunerative branches of Brazilian agriculture.

"Between Santos and San Paulo, near San Bernardo, I saw large and productive tea plantations. The manner of its culture differs but little from that adopted in China. Tea is raised from the seed, which, being preserved in brown sugar, can be transported to any portion of the country.. These little tea balls are planted in beds, and then, in the manner of cabbage plants, are transported to the field, and placed five feet apart. The shrubs are kept very clean, by the hoe or by the plough, which, though a recent introduction, has on some plantations been eminently successful for this purpose.

"The shrubs are never allowed to attain a height of more than four feet; and the leaves are considered ready for picking the third year after planting. The culture, the gathering, and the preparation of tea are not difficult, and children are profitably and efficiently employed in the various modes of arranging it for market. The apparatus used is very simple, consisting of—1. Baskets, in which the leaves are deposited when collected; 2. Carved frame-work, on which they are rolled, one by one; 3. Open ovens, or large metallic pans, in which the tea is dried by means of a fire beneath. Women and children gather the leaves and carry them to the ovens, where slave men are engaged in keeping up the fire, stirring, squeezing, and rolling the tea, which operations are all that it requires before packing it in boxes for home sale, or for exportation to the neighboring provinces.

"The tea plant is a hardy shrub, and can be cultivated in almost any portion of Brazil, though it is, perhaps, better adapted to the south, where frosts prevail, and which it resists. If left to itself in the tropics, it will soon run up to a tree. The coffee tree requires rich and new soil and a warm climate, unknown to frosts; but the tea plant will flourish in any soil. Dr. ——, who visited various portions of China, is of the opinion that the cha can be grown in any part of the United States, from Pennsylvania to the Mexican Gulf. There are not many varieties of the plant, as is often supposed, black and green teas being merely the leaves of the same tree, obtained at different seasons of the year. The flavor is sometimes varied, as that of wines from the same species of grape grown on different soils. The plant is not deciduous, as in China, and in Brazil is gathered from March to July, which, in the northern hemisphere, would correspond to the interval between September and January.

"I was informed that several million pounds are now annually prepared in the provinces of San Paulo and Minas Geraes, and its culture is on the increase.

"Some years ago the tea planters were greatly discouraged; for the cha was badly prepared, was sold too new, and hence the demand did not increase. But, since a greater experience in its culture and preparation, a better article for this favorite beverage has met with corresponding encouragement. Formerly, the cultivators said that, if they could obtain sixteen cents per pound, wholesale, it would be as remunerative as coffee. In 1855, twenty cents for the poorer article could be obtained; and for superior qualities, the greater portion of the crop, forty cents per pound, wholesale, was readily commanded. The demand for it is constantly increasing. When rightly prepared, it is not inferior to that imported from China. Much, indeed, of the tea sold in the province of San Paulo as cha da India, has merely made the sea-voyage from Santos to Rio de Janeiro, and there, after being packed in Chinese boxes, is sent back to the Paulistas as the genuine aromatic leaf from the celestial empire. I have seen foreigners in Brazil, who esteemed themselves *connoisseurs* in tea, deceived by the best cha naçional.

"A few years ago Mr. John Rudge, of the province of San Paulo, sent some tea from his plantation as a present to his relatives in Rio de Janeiro. This was prepared very nicely, each separate leaf having been rolled by the slaves between the thumb and forefinger until it looked like small shot. It was thus invested with a foreign appearance, packed in small Chinese tea-caddies, and shipped at Santos for the capital. When the caddies arrived, they were seized at the custom-house as an attempt to defraud the revenue. It was, on the other hand, insisted that the boxes contained cha naçional, although by neglect they did not appear upon the manifest. The parties to whom the tea had been sent offered to have it submitted to inspection. The caddies were opened, and the custom-house officials screamed with triumph, adding to their former suspicions the evidence of their senses, for the sight, the taste, the smell of the nicely-prepared tea proclaimed emphatically that it was cha da India, and that this was an attempt to defraud his Imperial Majesty's customs. It was not until letters

were sent to Santos, and in reply the certificates of that provincial custom-house had been received, that the collectors at Rio were satisfied that there was no fraud, and that the province of San Paulo could produce as good tea as that brought around the Cape of Good Hope.

"A few years may suffice to show, on the pages of the 'Commerce and Navigation' of Great Britain and the United States, that tea enters largely into the articles of importation from Brazil. Fifty years only have elapsed since the first cargo of coffee was shipped from Rio de Janeiro, and now Brazil supplies two thirds of the coffee of the world. The revolution in Hayti was the commencement of a new era for the coffee of Brazil.

"In 1846, Dr. —— learned that several planters were about to root up their tea shrubs. He besought them not to carry out their intention, 'for,' said he, 'there is to be a great revolution in China, [in 1845 he had been informed, in the Celestial empire, of the existence of the Triad society,] and the price of teas will be sure to go up in a few years.' The disheartened planters were encouraged to go on, and only a short time before my visit to Limeira, one of these fazendeiros sent to Dr. —— several pounds of most excellent tea, at the same time assuring him (the doctor) of his deep gratitude for having been prevented from the destruction of his plantation. He had found it exceedingly remunerative, and next year he intended to enter into more extensive operations.

"Throughout the world the use of tea is becoming as universal as that of coffee, and any continued disturbance in China must bring into prominent notice the tea culture of Brazil. The product is now almost entirely used within the empire; but the adaptability of the culture to almost any portion of the immense territory, and the ease by which it can be carried on, will doubtless, in a very brief period of time, fully develop this new source of national wealth."

In the United States a single enterprise, upon a very limited scale, indifferently managed, and early abandoned, is the only experiment in tea culture of which we have any record. Junius Smith, LL. D., of South Carolina, in 1848, imported a number of shrubs of from five to seven years' growth, and caused them to be planted at Greenville, in that State. In March, 1851, they were removed to a neighboring plantation. About this period Dr. Smith wrote concerning them, as follows: "They grew remarkably last summer, and are now fully rooted, with fine large main and collateral roots, with an abundance of fibrous radicles. They all stood the snow, eight or nine inches deep upon the level, on the 3d of January, and the severe frosts of winter, without the slightest covering or protection, and without the loss of a single plant. They are now all forming part of the plantation, composed of those received from China last June and a few planted the first week in June, which germinated the 17th of September. All these young plants were thinly covered with straw. Some of them have lost their foliage, others have not; the stems do not appear to have sustained any injury; the fresh buds are beginning to shoot. I cannot help thinking that we have now demonstrated the adaptation of the tea plant to the soil and climate of this country, and succeeded in its permanent establishment within our borders." Little

more is known of these plants, except that, being neglected, they have perished, unless a few isolated specimens have been preserved as subjects of curiosity. Last spring, however, Mr. S. P. Buckley, a well-known writer on horticulture, communicated to a New York periodical (the "Country Gentleman") the following statement: "A few days ago I drank a cup of real American tea, from the Chinese tea plant, of which Dr. J. P. Barratt, near New Market, South Carolina, has a fine shrub about four feet high, which has borne fruit during several years. By its side was a thrifty specimen of the olea fragrans, or Chinese olive, with which the tea is scented. * * * I was recently at Greenville, in this State, where Junius Smith, some years ago, essayed its culture. I was told that his experiment was by no means a true test. His soil was barren, and he took no pains to improve it. The plants did not receive proper nourishment, and, not being used to such treatment, they pined and died."

Although many varieties of tea are known in commerce, they are not the products of as many different species of the tea plant. Burnett says, (see "Outlines of Botany:") "Of the genus thea there are but three or four known species, and of these two only, viz: thea viridis and thea bohea, afford the leaves which are so extensively used in infusion, as the common morning and evening beverage in this country, (England,) and in other parts of Europe, as well as in China. Indeed, some authorities declare that the black and green teas are not the produce of different species, but merely varieties of thea viridis, which, according to soil and culture, will produce either green tea or black; and that the thea bohea of botanists does not enter essentially into the manufacture, although its leaves, as well as those of different species of camellia, may be introduced accidentally, or be mixed designedly, as an adulteration." These are the commonly received opinions on this subject, but Mr. Fortune, whose opportunities of obtaining correct information have been very ample, asserts that both green and black tea are made from each of the two species named, the difference in the article produced depending upon the period of gathering and the process of manufacture.

But one species forms the subject of the present experiment—thea viridis. For the instruction and guidance of the American cultivator the following information has been elicited from Mr. Fortune, in response to inquiries presented to him by the Patent Office concerning the culture of the tea plant in China and India:

The principal tea districts in China, which supply the greater portion of the teas exported to Europe and America, lie between latitude 25° and 35° north; the finest districts between 26° and 35°, and between longitude 110° and 120° east of Greenwich. The Indian districts in which tea is cultivated, between the 26th and 32d degrees of north latitude, and the 75th and 95th degrees of east longitude. The chief districts are Assam, Cachar, Dehra-Dhoon, Almorah, and Kangra, in the Punjaub.

In China, the lower slopes of the hills are preferred, at 1,000 feet above the level of the sea; in India, from 2,000 to 6,000 feet. The best description of soil for the tea plant is a light loam, well mixed with sand, and enriched with vegetable matter, moderately moist, but

neither wet nor sour. Sloping or undulating land of this kind, on which good crops of millet and Indian corn may be produced, is likely to be suitable. Any aspect will do, but east and west are preferred. The tea plant will not flourish in a wet or stagnant soil. Those on which it succeeds best vary in their constituent elements in the several districts. With respect to climate, the following abstract of observations in the open air, in a shaded situation, at Shanghai, in latitude 31° 20′ north, the maximum of the day, and the minimum at night, taken by a self-registering thermometer, will afford satisfactory data for comparison. In the tea mountains, to the west of this, the thermometer sinks several degrees lower in the winter months:

Abstract of Observations.

Years 1851 to 1858, inclusive.		Maximum by day.	Minimum by day.	Maximum by night.	Minimum by night.	Average by day.	Average by night.	Rainy days.	Amount of rain.
January,	1851	65°	42°	45°	24°	51°	33°	7	1⅞ in.
	1852	66	25	40	18	48	30	3	¼
	1853	66	30	43	18	45	30	10	10¾
	1854	67	32	53	24	51	37	9	3
	1855	52	33	40	18	44	25	4	1½
	1856	54	40	42	18	47	20	7	2½
	1857	58	34	44	18	49	30	3	¼
	1858	57	....	....	27	46	35	16	....
February,	1851	65	38	42	26	49	34	10	2⅝
	1852	60	38	40	19	45	31	13	2½
	1853	56	33	40	20	45	31	11	1¾
	1854	62	32	43	25	44	32	12	5¼
	1855	68	35	45	18	51	30	5	¾
	1856	60	30	42	15	44	31	13	4½
	1857	65	38	45	28	50	36	13	4¾
	1858	68	....	....	28	47	36	11	....
March,	1851	63	40	55	28	52	41	16	6⅜
	1852	62	43	45	33	51	38	12	3¼
	1853	67	46	57	35	56	42	10	5
	1854	67	42	47	32	52	41	10	3¾
	1855	72	36	57	30	55	41	11	4¼
	1856	73	40	50	26	55	39	6	1¾
	1857	72	45	56	31	54	43	10	5
	1858	72	....	....	33	53	41	10	....
April,	1851	70	50	56	33	59	48	21	9⅛
	1852	72	50	61	35	62	48	10	1¼
	1853	79	50	60	38	63	50	17	6¼
	1854	75	56	60	40	64	49	10	2
	1855	82	52	67	37	63	51	15	11½
	1856	88	54	62	42	65	51	9	3½
	1857	78	53	62	36	66	54	10	3¼
	1858	85	....	....	41	67	49	10	....
May,	1851	83	60	68	47	70	57	5	2¼
	1852	84	60	68	52	73	60	8	1⅝
	1853	86	62	68	50	72	59	11	4
	1854	84	64	70	37	73	61	15	5½
	1855	90	60	73	50	74	63	18	8½
	1856	92	60	73	46	73	61	11	4½
	1857	82	65	70	50	71	59	14	7¼
	1858	83	....	....	54	70	59	16	....

ABSTRACT—Continued.

Years 1851 to 1858, inclusive.		Maximum by day.	Minimum by day.	Maximum by night.	Minimum by night.	Average by day.	Average by night.	Rainy days.	Amount of rain.
June	1851	83°	68°	75°	60°	77°	67°	10	11 in.
	1852	99	66	81	58	81	73	17	5¾
	1853	93	70	78	59	81	69	13	4
	1854	90	71	80	62	79	69	10	7¼
	1855	90	73	79	56	79	70	7	5
	1856	88	68	77	64	80	66	3	2
	1857	90	67	78	59	82	70	11	6¾
	1858	87	....	....	59	80	68	10	....
July,	1851	96	70	81	66	88	75	7	4¼
	1852	100	82	81	75	92	78	8	3¼
	1853	99	83	81	77	90	80	2	½
	1854	98	72	84	70	86	78	13	14
	1855	94	82	82	73	89	78	8	5
	1856	96	77	81	70	89	78	2	1/16
	1857	96	75	80	74	89	78	7	5
	1858	94	....	....	68	87	76	16	....
August,	1851	93	76	82	63	87	77	11	9
	1852	94	82	82	67	88	76	7	3¼
	1853	95	82	80	70	86	73	13	13¾
	1854	99	75	81	65	89	79	10	8
	1855	99	83	81	75	87	78	12	7½
	1856	95	85	82	74	90	79	6	1
	1857	96	76	80	68	89	76	5	2
	1858	90	....	....	67	83	74	14	....
September,	1851	89	66	77	51	78	67	11	4½
	1852	92	70	79	56	79	66	10	6¼
	1853	90	70	78	64	82	70	12	7½
	1854	90	66	79	59	80	69	9	4
	1855	88	70	78	58	81	70	8	4½
	1856	90	70	80	58	82	72	15	4½
	1857	88	65	80	60	79	68	17	11¾
	1858	87	....	....	63	80	70	14	....
October,	1851	90	57	72	43	70	51	10	1¼
	1852	83	62	70	49	74	58	4	2⅛
	1853	88	65	77	46	73	60	6	1¼
	1854	88	63	70	50	74	60	5	1
	1855	80	65	69	45	73	58	3	1¾
	1856	84	60	73	45	70	59	11	5¼
	1857	82	60	75	53	72	60	12	5¼
	1858	76	....	....	45	70	57	5	....
November,	1851	76	55	60	41	66	48	10	4¾
	1852	80	53	62	32	64	48	2	7
	1853	76	48	65	32	66	50	14	4¼
	1854	76	52	60	31	66	45	3	1½
	1855	78	55	62	33	62	49	11	4
	1856	75	60	57	32	68	45	....	....
	1857	78	50	62	39	62	46	6	2¼
	1858	73	....	....	26	63	44	....	....
December,	1851	64	45	47	25	54	36	5	½
	1852	65	42	52	19	54	32	1	⅛
	1853	66	40	46	27	54	38	3	¾
	1854	66	40	46	26	55	39	4	½
	1855	73	40	43	22	60	36	....	....
	1856	76	38	47	26	57	35	3	....
	1857	64	....	....	31	53	42	12	....
	1858	57	....	....	31	51	40	18	....

In the Fokien districts, where black tea is generally produced, the ice is never of any considerable thickness, and the snow lies only on the tops of the mountains, rarely so far down as the tea plantations. In the northern districts of Hwuychow, Honan, and Hopek, ice is often found from two to four inches thick, the ground frozen six to eight inches, and the snow from one to two feet deep, though rarely, as the winter months are comparatively dry. But the sun, even in winter, has considerable power, and the snow does not lie long on the ground. A climate having abundance of rain is advantageous to this plant, particularly if the rain falls in the spring and summer months, say from April to July.

The tea plant is an evergreen, not unlike the camellia, though by no means so retentive of its leaves in winter. Sometimes the plants are ten feet high in a wild state, but they never form stems of great thickness, two or three inches in diameter being the largest. The young leaves only are gathered, and in young plants they are usually from two to three inches long. Some kinds of fine teas, such as the flowery "Pekoe," are made of partially developed leaves. When the leaves are very large and succulent, they are not considered suitable for the manufacture of good tea, especially if they are old. When produced from seeds, the tea plant first flowers in the second year, rarely in the first. It is not usual to propagate it from cuttings in China, but it would no doubt flower the first year if the cuttings were taken from full-grown plants. The usual period of flowering is in November, and the seeds ripen the next autumn. The number of seeds produced by a shrub depends upon its size and health. Vigorous plants produce fewer than the sickly and stunted. A great number of the young clusters are pulled in gathering the leaves, and may be seen in the tea brought to America. The seeds are preserved, preparatory to sowing, by being mixed with damp sand and earth. They are sown at any time after they are ripe before April of the following year. Beds about four feet wide are prepared, and the seeds are sown in rows across these beds in the way common in our nurseries. In the field they are planted four or five in a hole,* the bunches usually about four feet from each other, in rows. The ground is prepared for planting by being dug, or trenched, in the usual way. Manure is rarely used in tea culture in China; but where the land is poor, stable litter and sewage of all kinds are sometimes applied, indiscriminately, in moderate quantities, and a top-dressing of rich loam is considered valuable. The best time to apply manure is in the spring, before the plants begin to grow, or during mild weather in winter. In transplanting, if the ground has been well prepared, the holes need not be much larger than the size of the roots requires; but if this has not been the case, the holes should be at least eighteen inches in diameter and in depth. The same rules apply to tea plants and to our fruit trees. The shrubs should be planted about as deep as in their original beds. The roots of a full-grown shrub ordinarily descend two to three feet, and extend laterally from the stems about two feet on each side. The plant usually attains a height of from three to five feet, when fully grown in a cultivated

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* Singly, it is believed, will be the preferred mode in this country.

state, or it is kept at this height, and round and bushy, that it may yield a large crop of leaves. When it is about eighteen inches high, the leading shoots are pinched off, and the shrub is forced to throw out laterals. Naturally, it has a tendency to grow tall and straggling, with few side shoots. The object of pruning, or rather pinching off the ends of the shoots with the fingers, is to force each plant to form hundreds of little shoots, and to assume a round and bushy outline. As the leaves used in making tea are produced yearly at the ends of the shoots, the object of this system of treatment is apparent. It is practised during the tea-gathering season, so that nothing may be wasted, all being made into tea.* A small crop of leaves may be gathered the third year after planting. In the eighth or tenth year, the produce may be considered at its maximum.

In China, in consequence of the continual plucking of the leaves, the tea plant remains in full bearing only twenty-five or thirty years, when it becomes feeble and stunted, and can no longer be cultivated profitably. The usual annual product is as follows:

Tea produced in 3d year, 10 pounds to an acre.
Tea produced in 4th year, 30 pounds to an acre.
Tea produced in 5th year, 80 pounds to an acre.
Tea produced in 6th year, 120 pounds to an acre.
Tea produced in 7th year, 150 pounds to an acre.
Tea produced in 8th year, 200 pounds to an acre.
Tea produced in 9th year, 250 pounds to an acre.
Tea produced in 10th year, 300 pounds to an acre.

For ten or fifteen years longer, the maximum of 300 pounds may be kept up by judicious management. The Chinese cultivators are most careful in gathering the leaves. They know well that the continual plucking has a tendency to make the bushes unhealthy, and consequently they do not gather from very young plants, nor from those which are not vigorous and healthy. For the first three years the chief object is to form the plants, as has been already described. Stunted, unhealthy bushes are always passed by in the gathering season.

While the instruction thus derived from the experience of the Chinese is worthy the attention of every American cultivator, a servile adherence to it is not desired. With our superior implements and superior skill in husbandry, and with the unceasing efforts of our people to improve upon past usages, it can hardly be otherwise than that the labor of cultivating and manufacturing tea will be greatly facilitated, and that acceptable and even improved qualities may soon be produced at lower prices than the imported varieties now command in general commerce. In accordance with this practical view, a note has been prepared for the instruction of those to whom the plants are to be committed for culture, in the following words:

"The tea plant is a half-hardy evergreen shrub, thickly branched, with dark coriaceous foliage. Under cultivation it grows from four to six feet high. It is seldom attacked by insects, and is sufficiently hardy to flourish where the temperature in winter does not fall below

* The early spring, before budding, will doubtless prove the proper time.

'2° of Fahrenheit. It may be readily propagated from seeds, from ayers, and from cuttings. The seeds may be sown from two to three nches deep, in rows, and they will germinate in from two to three months. They grow from six to ten inches high the first season, and in the following spring may be planted out to the sites in which they are to remain. The ground should be kept clear of weeds, and occasionally loosened about their roots. In September the lower branches may be laid in the ground, and kept covered with sandy soil, until the next autumn, when they should be severed from the parent stock and removed to the plantations prepared for them. Cuttings may be taken in October from well-ripened shoots. The operator should cut smoothly across, at a joint, with a sharp knife, and remove two or three of the lower leaves, and then plant the cuttings in boxes of sand, making them firm with a small dibber. The boxes should then be placed in a cold frame and kept shaded during sunshine. In the next spring, those that have taken root will begin to grow, when their progress may be accelerated by a gentle bottom heat; and in autumn they may be planted out in rows, six feet apart, the shrubs standing five feet apart along the row."

In order that this enterprise may be judiciously conducted, it is proposed to supply to each experimenter, in those regions in which the shrub may be expected to flourish in the open air, a sufficient number of plants to occupy a few square rods of ground. Accordingly, there will be but one consignment to each congressional district, and that to some intelligent and responsible person, selected with the assistance of the representative of the district. As it is supposed that the plant cannot be cultivated in the open air north of the northern boundaries of Tennessee and North Carolina, but must be protected in heated conservatories and green-houses during the winter, they will be distributed among from fifty to a hundred persons in the States, respectively, north of the above-named line, for the gratification of the taste and the curiosity of the public. The names and address of these persons, also, have been obtained through the aid of their representatives in Congress. The distribution will be made in February and March, 1860, and the intended recipients will be duly notified thereof.

The Chinese processes of gathering, rolling, drying, coloring, scenting, and packing tea for commerce, have frequently been described in English and American publications, and partially in the Patent Office Report for 1857. Rolling, coloring, and scenting will probably be wholly omitted in the manufacture in this country. The discussion of the other operations will be in season hereafter, when the public mind shall have been drawn more practically and interestedly to the subject.

Pyrethrum caucasicum, 250 *plants:* This plant, from which the Persian insect powder is obtained, is partially known in the United States. It was described in the Patent Office Report for 1857. It bears white flowers, in July and August, like those of the oxeye daisy, (chrysanthemum leucanthemum,) and is propagated by the division of its root and by seeds. It is a herbaceous perennial, and flowers the first year.

Achillea rosea, 200 *plants:* A pretty border plant, with beautiful red flower, having an aromatic, agreeable smell, and bitter, pungent

taste. It is a variety of the common perennial, (achillea millefolium,) in the dry pastures and on the steep banks of rivers in Great Britain, known as millfoil, or yarrow, which has been used medicinally as a narcotic, and applied to the manufacture of beer. The usual height of the achillea rosea is six inches, but the flower stem ascends twelve inches above it. The flowering season is in June, July, and August, the brilliant hues becoming pale as the season advances.

The cork tree, (quercus suber,) 250 *plants:* This tree is fully described in the Patent Office Report for 1858, and has been partially introduced to the country by means of the distribution of a large quantity of its acorns; yet, so general has been the neglect or want of knowledge respecting their culture, that the successful propagation from acorns at this garden is deemed essential to the success of the experiment. The habitat of the cork tree does not, probably, extend north of Maryland.

The mahonia, 5,000 *plants:* This is an evergreen shrub, four feet high, having yellow flowers, succeeded by brilliant red berries. It is known in some parts of the United States, whence, indeed, it was introduced to Europe. It is, probably, the mahonia fascicularis; natural order, berberideæ.

Seedling strawberries, 1,000 *plants.*

Virgilia lutea, 200 *plants:* This is a deciduous shrub. It attains a height of fifteen feet, and, in Europe, flowers in June and July. It is a native of North America, and is well known in Tennessee. The wood is yellow, and dyes a beautiful saffron color.

The camphor tree, 21 *plants:* There are already a few specimens of this tree in botanical collections in the United States. It is a native of Japan. The roots, wood, and leaves have a strong odor of camphor, which is found everywhere in the interstices of the fibers of the wood and in the pith, but most abundantly in the crevices and knots. The camphor of commerce is obtained not only from this tree, (laurus camphora,) but also from the dryobalanops camphora, a native of Sumatra, which yields a harder, more brittle, and more highly-valued gum. The camphor tree is tall and divided into many branches, covered with smooth greenish bark. It may be propagated from seeds or from cuttings.

Pinus edulis, 100 *plants:* This tree is from Oregon. It is of rapid growth, and very ornamental. The Indians esteem the seeds a great delicacy.

Sycamore fig, 50 *plants:* The platanus occidentalis of Linnæus, commonly called button-wood or cotton tree, is erroneously called sycamore also. The true sycamore, in size and appearance, resembles a mulberry tree, but bears a species of fig. It is found in Palestine, and is believed to be the tree mentioned in Luke xvii: 6, and elsewhere in the New Testament.

Arbor vitæ, (species, thuja,) 1,500 *plants:* The arbor vitæ of the United States, (thuja occidentalis,) is a well-known evergreen shrub, assuming the form and height of a tree in Canada, its native locality, and growing best in swamps and marshes. That now introduced very nearly resembles the American species; but Mr. Fortune states that, in China, it is the most ornamental of the species he has seen.

Rhus succedanea, (wax plant,) 150 *plants:* An evergreen shrub,

ten feet high. It is half-hardy, and flowers in June. It was first introduced into England, from China, in 1768. The plants now under cultivation are from seeds obtained in Japan. The seeds yield an oil, by expression, of the consistence of suet, which is used in China and Japan for making candles. Its sap is resinous, and might be used as varnish.

Tung oil tree, 50 *plants*: Also from Japan.

Oodung, and other ornamental trees from Japan.

Olea fragrans, or fragrant olive, called Lan-hoa by the Chinese, who use the leaves and blossoms in scenting their teas.

Ilex vomitoria: This plant, according to Burnett, is known as yopon and emetic holly. It is indigenous to North Carolina, and found along the coast thence to Florida. Its properties were known to the Indians, who used an infusion of its leaves as an agreeable beverage, and at a certain time in the year purified themselves by drinking it very strong, and in copious drafts, for two or three days, throughout which period it operated as an emetic. Though it is not pleasing to the uneducated taste, poor people in the eastern portions of North Carolina use it as a substitute for tea; and the captains of many vessels take supplies of it to sea, because, as they believe, the sailors are in better condition while using it than when supplied with coffee. It usually grows wild, but, when brought under cultivation and training, it becomes a beautiful tree, though not often more than fifteen feet high.

It is the popular belief in the United States that this plant is identical with the Ilex Paraguayensis, Yerba maté, or Jesuits' tea, of Paraguay; but this is an error. Nor is the Ilex gongonha, of Brazil, identical with either. The tree of Paraguay is greatly superior, and possesses an importance in that country little appreciated elsewhere. In 1854, the president of the province of Paraná alluded, in his annual message, to the fact that wheat had been an article of export, but had been abandoned because "a large portion of the population, eschewing the labor required in the production of the cereals, rush to the virgin forests, and there, stripping the evergreen leaves and the tender branches of the Ilex Paraguayensis, easily convert them into the popular South American beverage known as the yerba maté, or hewa Paraguaya, and thus amass fortunes, or obtain a livelihood without the intervention of persevering industry or great exertion." Large quantities of this kind of tea were annually exported from the province of Paraná until interdicted by the government.

"While in Paranaguá," says an authority already quoted, (Kidder and Fletcher's Brazil,) "I observed many raw-hide cases, which the blacks were unloading from mules, or conveying to the ships riding at anchor in the beautiful bay. Upon inquiry, I learned that these packages, weighing about one hundred and twenty pounds each, consisted of maté. This substance, so little known out of South America, forms truly the principal refreshing beverage of the Spanish-Americans south of the equator, and millions of dollars are annually expended in Buenos Ayres, Bolivia, Peru, and Chili, in its consumption. This town of Paranaguá, containing about three thousand inhabitants, exports every year nearly a million dollars' worth of maté.

"It can be gathered during the whole year. Parties go into the

forest, or places where it abounds, and break off the branches with the leaves. A process of kiln-drying is resorted to in the woods, and afterward the branches and leaves are transported to some rude mill, and there they are, by water-power, pounded in mortars.

"The substance, after this operation, is almost a powder, though small stems, denuded of their bark, are always permitted to remain. By this simple process the maté is prepared for market. Its preparation for drinking is equally simple. A small quantity of the leaf, either with or without sugar, is placed in a common bowl, upon which cold water is poured. After standing a short time boiling water is added, and it is at once ready for use. Americans who have visited Buenos Ayres or Montevideo, may remember to have seen, on a fine summer evening, the denizens of that portion of the world engaged in sipping, through long tubes inserted into highly-ornamented cocoanut bowls, a liquid which, though not so palatable as iced juleps, is certainly far less harmful. These citizens of Montevideo and Buenos Ayres were enjoying, with their bombilhas, a refreshing draught of maté. It must be imbibed through a tube, on account of the particles of leaf and stem which float upon the surface of the liquid. This tube has a fine globular strainer at the end.

"Great virtues are ascribed to this tea. It supplies the place of meat and drink. Indians, who have been laboring at the oar all day, feel immediately refreshed by a cup of the herb, mixed simply with river water. In Chili and Peru, the people believe that they could not exist without it, and many persons take it every hour of the day. Its use was learned from the natives; but, having been adopted, it spread among the Spaniards and Portuguese, until the demand became so great as to render the herb of Paraguay almost as fatal to the Indians of this part of America as mines and pearl fisheries had been elsewhere.

"It grows wild, and never has been successfully cultivated, although attempts were made by the Jesuits of Paraguay to transplant it from the forests to their plantations. These attempts have been considered by many without result; still, there are others who consider that the experiment justifies further efforts, and are urging this day the domestication, so to speak, and the cultivation of maté under a regular system."

Don states ("System of Gardening and Botany") that "there are three kinds of Paraguay tea, but all procured from the same plant. These go under the names of caa-cuys, caa-mini, and caa-guazu. The first is prepared from the buds, when the leaves are scarcely expanded; the second of the membrane of the leaves stripped off the ribs before roasting; and the third consists of the leaves roasted entire, without any selection. The caa-cuys does not keep, and is consequently all used in Paraguay; and the aromatic bitterness even of the others is lessened by time and partly dissipated by carriage. The principal harvests of this herb are reaped in the eastern parts of Paraguay, and about the mountains of Maracaya; but it is also cultivated in the marshy valleys between the hills. The natives boast of the innumerable qualities the tea possesses, and in the mining countries its use is almost universal, from the opinion that prevails among the Spaniards

that the wines are there prejudicial to health. Like opium, it produces some singular effects; it gives sleep to the restless and spirits to the torpid. Persons who have once contracted the habit of taking it do not find it an easy matter to leave it off, or even to use it in moderation, although, when drank to excess, it brings on disorders similar to those which are produced by the immoderate use of spiritous liquors."

Grape vines, 25,000 *plants:* These embrace seedlings and rooted cuttings from not less than fifty varieties of native and foreign grapes, among which may be named:

Hungarian, four varieties.

El Paso, seedlings and cuttings, two varieties, the blue and the white.

Hartford prolific, Connecticut.

Clinton, New York.

Diana, Massachusetts.

Concord, Massachusetts.

Seedling, Massachusetts.

Union Village, Ohio.

Delaware. Ohio.

Rebecca, New York.

Saluda, South Carolina.

Scuppernong, North Carolina and Virginia.

Washita, white, Arkansas.

Devereaux, South Carolina.

Herbemont's Madeira, Georgia.

Lenoir, the Carolinas.

Anna, Ohio.

Logan, New York.

Catawba, southern.

Isabella, North Carolina.

Wyoming, Pennsylvania.

Red Venango, Tennessee.

Canby's August, southern.

Black July, France.

Minor, Massachusetts.

Clara, Pennsylvania.

Elbling, northern.

Lincoln Downer, northern.

Traminer, Germany.

Trollinger, northern.

Chasselas de Fontainebleau, France.

Sweet water, foreign.

Black Hamburg, foreign.

Seedless, (large,) Egypt.

Lady's finger, (berries three inches long, three fourths of an inch in diameter, delicious flavor,) Egypt.

Grahamii, northern.

Frankenthal, foreign.

Dracot amber, Massachusetts.

Grevaduly, Massachusetts.

Henshaw, Pennsylvania.
Franklin, (fruit black,) Pennsylvania.
Burgundy, (fruit black,) foreign.
Black prince, (fruit black,) foreign.
Harris, (fruit black,) northern.
To-kalon, (fruit red,) New York.
Emily, (fruit red,) northern.
Garrigues, (fruit dark purple,) Delaware.
Cassady, (fruit white,) northern.

In view of the generally received opinion that the native vines alone are adapted to the production of good wine in the United States, it is proper to explain that the object in introducing foreign varieties into this collection is to produce such hybrids as may inherit the better qualities of both originals. It is believed that salutary and important results may be realized from the skillful, careful, and persistent prosecution of experiments of this character.

SEEDS FOR DISTRIBUTION.

In the fulfillment of orders made previous to the appropriation of March, 1859, an assortment of seeds has been imported from Europe, and portions of them distributed among the State and local agricultural societies in those sections of the Union to which they are believed to be applicable respectively, while an adequate quantity of each has been retained for propagation at this garden. Among those possessing novelty or merit may be named the following:

Early Washington peas: An excellent pea of American origin, though produced from European varieties; known as the extra-early.

Chautong yellow oil pea: From China; it abounds in oil, but is not suitable for edible uses.

Chautong green oil pea: Same origin, and varying but little from the above.

Matchless marrow pea: An excellent variety, the merits of which are well known in the United States.

Ice drum lettuce: A fine variety.

White Paris cos lettuce: Also a good and well-known variety.

White solid celery: An admirable variety.

New York purple egg-plant.

Early Winningstadt cabbage: English; one of the best varieties, of easy culture and delicious flavor.

Dutch horn carrot: An excellent and well-known variety.

Onion, (Bassel:) From Egypt; not equal to varieties now cultivated in the United States.

Melochia, (Corchorus olitorius:) A novel plant, the leaves of which afford a mucilage relished in soup.

Ice-cream watermelon.

New hybrid Marvel of Peru: A pretty flowering border plant, blooming from June to September; adapted to light soils.

Trifolium incarnatum: A good flowering variety, but tender; adapted to lawns.

Pyrethrum caucasicum: A fine flowering herbaceous perennial plant, already described. It is in character like the feverfew.

Linum grandiflorum rubrum: Grand red flowered flax; height, eighteen inches; blooms from May to September.

Trifolium Alexandrinum: From Egpyt; a poor variety of clover, like lucern.

Broughton early seed wheat: Has been highly commended wherever it has been fairly tried. Mr. Peter Gorman, of Howard county, Maryland, says of it: "I received from the Patent Office, in the autumn of 1858, a half bushel of 'Tappahannock wheat,' which I sowed broadcast, with the aid of a small plough to cover it suitably, the 16th of October, 1858. On the 17th June, 1859, it was ripe and fit for harvest, but I did not cut it until the 21st. In August, I had it threshed by a machine, and found the yield to be sixteen bushels and two quarts merchantable wheat, weighing sixty-three pounds to the bushel, and a half bushel of small, light wheat. It ripens sixteen days sooner than other wheat, and thus escapes various diseases and casualties."

Orzomondo barley: European; very fine.

Sow-tow: China cotton seed; not known to have germinated. The specimens of the fiber are very white.

PLANTS FROM PALESTINE.

On the 12th of April, 1859, the Rev. J. T. Barclay, a Christian missionary from the United States to Jerusalem, in compliance with a request of the Patent Office, shipped at Jaffa (the ancient port of Joppa, thirty-one miles northwest of Jerusalem) a quantity of the seeds named in the following list; but, in consequence of unexpected delays in their transmission, they were not received at Washington until the 25th of October, when many of them were found apparently damaged from their protracted exposure. A portion of each variety has been retained for experiment and propagation, and the rest distributed among the State and local agricultural societies in the regions of the country to which they are believed to be adapted respectively. Minute descriptions of these plants had not been received from Mr. Barclay at the date of this report; and their classification and characteristics have in some cases been sought with no better guide than the local Arab names afford:

Carob tree, (Ceratonia siliqua:) This name is derived from *Κερας*, a horn, which was given to this tree because of its long, horn-like pods, containing a sweet fecula, and known in commerce as Algaroba beans. The Arabic name is khârûb. It is generally considered the locust tree of Scripture, and its fruit has been called St. John's bread, while the shells of the pods are supposed to be the husks of which the prodigal son desired to partake with the swine. The tree is common in the south of Spain. Its quality improves the further south it is found. In the south of Italy and of Greece it prospers well, and affords abundant fodder for swine and sheep. In Syria it is still more valuable, and in Egypt the pods are so thick, and so charged with sugar, as to be regarded as a delicacy by the common people, the dry pulp in which the seeds are buried being remarkably nutritious. It is said that

singers have derived benefit from chewing this fruit, their voices being thereby rendered more flexible. The carat weight of four grains is believed to have originated in the adoption of the seed of this tree as a standard.

Foosduck, or foostûk, (Pistacia vera:) This tree is common in the valley of Jericho, and elsewhere in Syria. It also abounds in Sicily, where it is cultivated for its nuts. The flowers come forth in clusters, and of herbaceous color, in April and May.

Senawber, or snowber: This also is a pistacia, (terebinthus,) but is ranked by Arab writers among the pine or turpentine trees. Its nuts are shaped like the filbert, long and pointed, the kernel being pale, greenish, sweet, and more oily than that of the almond. It grows in Syria, Arabia, Persia, and the island of Cyprus. The Cyprus turpentine is procured from the trunk, by wounding the bark in several places, in the month of July. From these wounds the turpentine flows upon receptacles arranged for the purpose, and, becoming condensed in the night, is scraped off in the morning, but is again liquified in the sun and strained for use. It is obtained in small quantities, however, four large trees yielding but two pounds, nine ounces, and six drachms. It is hence often adulterated in commerce.

Doora-esh-shamy, or Syrian maize: A hardy plant in Syria and Egypt. In Egypt there is also a variety called Doora-neely, which grows twelve or fifteen feet high, bearing, sometimes, from fifteen hundred to two thousand kernels of small corn in a single head or top. It propagates itself by new shoots from the old roots in the spring. There is also in Syria a Doora-es-seify, which is millet. Several varieties of it are now well known in the United States. The Doora-neely affords a very coarse meal, of which bread is made by the laboring people of Egypt, but it is more suitable for their horses and cattle.

Helbeh: A variety of clover, abundant in Egypt. Its stalks, shaded by the tops, are bleached, and are eaten as celery by the poorer classes. It is spoken of in Numbers, chapter xi, in connection with the cucumbers, the melons, the onions, and the garlic of Egypt; though the translators, unacquainted with this plant, have rendered the word leeks in the English version.

Fool: This is the Arabic name of a leguminous plant grown in the delta of the Nile, on the flat lands throughout Syria, and in small tracts in the deep valleys of the mountain ranges of the desert of Sinai. The peas or beans are sold in immense quantities to the desert Arabs, who feed their camels upon them. They are said to be sown broadcast, but this mode of culture is not commended to imitation in this country. The stalks attain the height of eighteen or twenty inches, standing thick and upright, bearing twenty or more round and slender pods, of from four to six peas each, of the size and shape of the marrow-fat pea. They become dark brown and somewhat shriveled when dry. The Arabs, as they pass along the immense fields, are fond of plucking and eating them green; but when dry, they are better suited to the lower animals. They are preferred to maize, or Indian corn, for the camels, being an exceedingly grateful and nutritious food. But little labor is requisite in planting, cultivating,

and gathering them, yet the yield is large. Doubtless they may be cultivated to great advantage in the southern portions of the United States. It is believed that Moll, in his work on agriculture in Algeria, has reference to this pea when he says: "The gray pea [pois gris] is preferred for forage, the yellow and green as food for man."

Semsem: This is the Sesamum Indicum of botany, belonging to the family pedaliaceæ, and is supposed to have been brought originally from India, though it is now cultivated in Arabia and Syria. It is an annual, grows eighteen inches high, and bears a pale purple flower in July. The seeds are used for bread. They are more oily than any of the cereals. This plant is abundantly cultivated in the valleys and on the plains of Syria; and one of the finest valleys in the western part of the hill country of Judea, about equidistant from Jerusalem and Gaza, and from Joppa and Hebron, is named Wady-Semsem, because of its producing this grain. Semsem is found in the Levant also, and in Africa, where it is grown as a pulse. An oil extracted from the seeds, Loudon asserts, will keep many years, at the end of two years becoming so mild as to supply the place of olive oil in making salads, and for other purposes. Puddings are made of the seeds, as of millet or rice. A pound of oil is obtained from four or five pounds of the seeds. The name of this plant has been preserved in the "open sesame" of the Arabian Nights. The bene plant, valued in the United States for its medicinal qualities, is a variety of this species.

Kirsenneh, or kersenna: This is a species of vetch, which ripens with the barley, and is beaten out in like manner. It is extensively cultivated in Syria, and, like lentils and barley, is consumed by the camels.

Lubia, or lubyeh: A species of pea or bean. El-Lûbyeh, a large village west of the lake of Tiberias, having a deep valley on the east and north, and by which passes the road from Nazareth to Tiberias, is named after this plant.

Hummas, or hûmmûs: A species of vetch, growing abundantly on the northern side of Syria, on the undulating lands back of Tyre, and elsewhere.

Addas, or adas: The lentil spoken of in Genesis xxv, 34. The lentil of Europe and of this country is an annual plant, growing about eighteen inches high, and its seeds, contained in pods, are round, flat, and a little convex in the middle. The lentil of Syria is pinkish red when ripe, and is excellent in soups, or when parched over the fire, prepared in which manner it is sold in the shops, being considered by the natives the best food to be taken on long journeys; but it is chiefly cultivated as food for cattle. It is often sown broadcast, but prospers better in drills. March is the time for planting, or as soon as the ground is dry enough for cultivation. A warm, sandy soil is adapted to this plant. It ripens sooner than the pea, and is harvested in like manner. The straw is delicate and nourishing.

Bamya, or burmyeh, (species, Melochia:) It is much like the okra, now common in the United States. The pods are six-sided, and grow on a bush from three to five feet high. When green they make excellent soup.

Khoosa and Khyar: These are two varieties of squash adapted to

table use. Syria and Egypt abound in excellent varieties of this vegetable.

Khumbers: An excellent species of flax.

HISTORICAL SKETCH OF THE UNITED STATES AGRICULTURAL SOCIETY.

This society, as its name imports, is a national institution, and was created in its present form by a convention or congress of farmers, composed of delegates from the several State societies, many of which are not only incorporated, but endowed as permanent State institutions.

Its organization was, therefore, in strict conformity with that of the general government, whilst its position is similar to that of the national societies in foreign countries, such as the Royal Agricultural Society of England and the Imperial Agricultural Society of France.

It resembles the government, also, in being the result or consequence of several unsuccessful experiments, dating almost from the commencement of our national existence.

The records of these efforts constitute, therefore, a part of the complete history of the present society, and have been carefully preserved among its archives.

As early as 1794, the formation of a National Agricultural Society appears to have occupied the attention of Washington, then President of the United States.

A letter addressed by him to Sir John Sinclair, on the 20th of July, 1794, contains the following reference to this subject: "It will be some time, I fear, before an agricultural society, with congressional aid, will be established in this country. We must walk, as other countries have, before we can run; smaller societies must prepare the way for greater; but, with the lights before us, I hope we shall not be so slow in maturation as older nations have been. An attempt, as you will perceive by the inclosed outlines of a plan, is making to establish a State society in Pennsylvania for agricultural improvements. If it succeeds, it will be a step in the ladder; at present, it is too much in embryo to decide upon the result."

The first proposition for the establishment of such an institution was made by Washington, in his annual speech, delivered on the 7th of December, 1796, when he met the two Houses of Congress for the last time. He said: "It will not be doubted that, with reference to either individual or national welfare, agriculture is of primary importance. In proportion as nations advance in population, and other circumstances of maturity, this truth becomes more apparent, and renders the cultivation of the soil more and more an object of public patronage. Institutions for promoting it grow up, supported by the public purse; and to what object can it be dedicated with greater propriety? Among the means which have been employed to this end, none have been attended with greater success than the establishment of boards, composed of proper characters, charged with collecting and diffusing informa-

tion, and enabled, by premiums and small pecuniary aids, to encourage and assist a spirit of discovery and improvement.

"This species of establishment contributes doubly to the increase of improvement, by stimulating to enterprise and experiment, and by drawing to a common center the results, everywhere, of individual skill and observation, and spreading them thence over the whole nation. Experience, accordingly, has shown that they are very cheap instruments of immense national benefits."

The Senate, in an address in answer to this speech, drawn up by Senator Read, of South Carolina, and adopted, after having been discussed and amended, said: "The necessity of accelerating the establishment of certain useful manufactures by the intervention of the legislative aid and protection, and the encouragement due to agriculture by the creation of boards, (composed of intelligent individuals,) to patronize this primary pursuit of society, are subjects which will readily engage our most serious attention."

A committee of the House of Representatives, composed of Messrs. Swift, of Connecticut, Gregg, of Pennsylvania, and Brent, of Maryland, made a report, on the 11th of January, recommending the institution of a society for that purpose, under the patronage of government, which might act as a common center to all other societies of a similar kind throughout the United States. The report is accompanied by a plan, the principal articles of which are that a society shall be established at the seat of government; that it shall comprehend the Legislature of the United States, the Judges, the Secretary of State, the Secretary of the Treasury, the Secretary of War, the Attorney General, and such other persons as may choose to become members, according to the rules prescribed; that an annual meeting shall be held at the seat of government, at which are to be elected the president, secretary, &c., and a board, to consist of not more than thirty persons, which shall be called the "Board of Agriculture;" that the society shall be a body corporate; that a report shall be made annually, &c. The report concluded with a resolution in these words:

"*Resolved*, That a society for the promotion of agriculture ought to be established at the seat of government of the United States."

The first national association of this description was the "*Columbian Agricultural Society for the promotion of Rural and Domestic Economy*," which was organized by a convention held in Georgetown, District of Columbia, on the 28th of November, 1809, at which a constitution was reported by General John Mason. Osborne Sprigg, Esq., of Maryland, was chosen president, Thompson Mason, Esq., of Virginia, vice president, and David Wiley, Esq., of Georgetown, secretary.

The *first agricultural exhibition in America* was the *national fair* held by this society at the Union Hotel, in Georgetown, District of Columbia, on the 10th of May, 1810. Among other premiums awarded were three, of $100, $80, and $60, respectively, for "two-toothed ram lambs," showing the great importance attached at that early day to improving the breed of sheep.

President Madison wore his inauguration coat, made from the merino wool of Colonel Humphrey's flock, and waistcoat and small clothes made from the wool of the Livingston flock, at Clermont.

The *first field trial of implements in America* was the plowing match at the fifth semi-annual exhibition of the Columbian Society, on the 20th of May, 1812. The war with England, which occurred at that time, overshadowed everything else; and, after holding a sixth successful exhibition, on the 18th of November, 1812, the time for which the society had been organized (three years) having expired, it was dissolved at the close of that year. Its successful exertions in awakening a more genial interest in the various departments of husbandry, not only in the immediate vicinity of its exhibitions, but in the adjacent States, merit a grateful remembrance by the agriculturists of America.

In 1840, Solon Robinson, Esq., and other gentlemen, anxious "to elevate the character and standing of the cultivators of the American soil," called a convention, which met at the city of Washington in 1841, and organized the "United States Agricultural Society." A constitution was adopted, and efforts were made to secure "that splendid donation of a munificent foreigner, with which to establish a great school and library of agricultural science and experiment, with a garden that should bear and be worthy of the name of Smithson." The establishment of the Smithsonian Institution prostrating the hopes of those who had expected to base a national agricultural institution upon his endowment, the United States Society never held a meeting after its organization. Such were the stages through which this undertaking was destined to pass before attaining its mature development in the *United States Agricultural Society.*

On the 14th of June, 1852, a National Agricultural Convention was held at the Smithsonian Institution, in the city of Washington, under a call issued by the following agricultural societies, at the instance of the Massachusetts Board of Agriculture: The Massachusetts State Board of Agriculture; Pennsylvania State Agricultural Society; Maryland State Agricultural Society; New York State Agricultural Society; Southern Central Agricultural Society; Ohio State Board of Agriculture; American Institute, New York; Massachusetts Society for the Promotion of Agriculture; Indiana State Board of Agriculture; New Hampshire Agricultural Society; Vermont Agricultural Society; and the Rhode Island Society for the Encouragement of American Industry.

The convention was composed of 153 delegates, representing 23 States and Territories. Among those who were present during its sessions were the Hon. Millard Fillmore, President of the United States, and the Hon. Daniel Webster, Secretary of State.

The following gentlemen composed the committee who drafted the constitution of the United States Agricultural Society: Messrs. Holcomb, of Delaware; Douglas, of Illinois; J. A. King, of New York; Steele, of New Hampshire; Thurston, of Rhode Island; Hubbard, of Connecticut; Stevens, of Vermont; Elwyn, of Pennsylvania; Calvert, of Maryland; Campbell, of Ohio; Hancock, of New Jersey; Callan, of the District of Columbia; G. W. P. Custis, of Virginia; Burgwyn, of North Carolina; Taylor, of Alabama; DeBow, of Louisiana; Spencer, of Indiana; Mallory, of Kentucky; Bell, of Tennessee; Weston, of Wisconsin; McLane, of California; Pickhard, of Maine; Dawson, of Georgia; French, of Massachusetts; and Seaman, of Michigan.

The objects of the society, as declared by the preamble to its constitution, are: to "improve the agriculture of the country, by attracting attention, eliciting the views, and confirming the efforts of that great class composing the agricultural community, and to secure the advantages of a better organization, and more extended usefulness among all State, county, and other agricultural societies."

Its officers consist of a president, one vice-president for each State and Territory, a treasurer, and secretary. Colonel Marshall P. Wilder, of Massachusetts, was elected president. On the list of its members are to be found the names of many of the most distinguished men in the nation, and it will compare favorably, in this respect, with any institution in the country.

The first *annual meeting* took place at Washington, on the 2d of February, 1853, since which they have been regularly held on the second Wednesday of January, constituting, in reality, the "Board of Agriculture," recommended by the Farmer of Mount Vernon. The annual meetings have been attended by the Presidents of the United States, heads of departments, and many of the most distinguished members of the houses of Congress. Gentlemen from almost every State in the Union (many of them delegates from agricultural associations) have annually assembled to discuss such topics as have been presented, calculated to advance the cause of agricultural improvement; interesting and valuable lectures have been delivered, and essays read by practical and scientific farmers; reports have been submitted by committees specially appointed to examine new inventions and theories, and by delegates who have been accredited to the agriculturists of other lands, and there has been a general interchange of opinion.

At the sixth annual meeting, the first change took place in the executive department, by the voluntary retirement of Colonel Wilder, whose energetic participation in the formation of the society, and whose enlightened administration of its affairs have contributed so largely to its usefulness and success. He was succeeded by General Tench Tilghman, of Maryland, the present incumbent; thus establishing the precedent of rotation between the different sections of the Union.

At this meeting, a report of extended experiments in the culture of Chinese sugar-cane in this country was made, by a committee of the society, through its chairman, Mr. D. J. Browne, (then superintendent of the Agricultural Division of the Patent Office,) and subsequently published in the Agricultural Report of the Patent Office, for 1857.* In this report, Mr. Browne says: "Conformably to the resolutions adopted by the United States Agricultural Society, at the city of Washington, in January, 1857," the committee appointed to investigate and experiment upon the sorgho sucré, or Chinese sugar-cane, with the view of determining its value, for the purpose of syrup and sugar-making, soiling cattle, use of the seed for feeding stock, for bread-making, and for the manufacture of paper and alcoholic liquors, beg leave to report as follows:

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*It will be seen by the Agricultural Report for the year 1856 that the first purchase of sorghum seed made by the Patent Office was in the autumn of 1854, and the second in 1855.

"Agreeably to the requirements, there was imported from France sufficient sorgho seed to plant one hundred acres of land. This seed was placed in the hands of a number of individuals, in different sections of the country, who cultivated it under various conditions of soil, climate, &c.

"From the results of their experiments, in ninety localities, between New Brunswick, in the British Dominions, and Mexico on the one hand, and between Florida and Washington Territory on the other, the committee are of the opinion that the sorgho sucré possesses qualities which commend it to the especial attention of the agriculturists of all parts of the country."

Annual exhibitions have been held at the following places: Springfield, Massachusetts, (1853;) Springfield, Ohio, (1854;) Boston, Massachusetts, (1855;) Philadelphia, Pennsylvania, (1856;) Louisville, Kentucky, (1857;) Richmond, Virginia, (1858;) and Chicago, Illinois, (1859.)

In July, 1857, a national trial, in the field, of reapers and mowers, was held at Syracuse, New York, unequaled by any similar exhibition.

The illustrated report of this trial, published by the society, is the most elaborate treatise that has ever been issued on this important and strictly American implement.

The exhibitions have been self-sustaining, the receipts meeting the disbursements of upwards of one hundred and thirty thousand dollars for premiums and expenses, whilst they have been strictly confined to legitimate objects, and avoided all extraneous attractions for the purpose of augmenting their receipts.

They have not only increased the efficiency of the State and local associations, but have elevated the standard of excellence in agricultural productions and processes, and extended the amount of agricultural information in the various parts of the country, by carrying into each, successively, articles of a superior quality, and, in many instances, of a different kind from those previously exhibited at the local fairs. They have called together larger assemblages of people than have ever been convened upon other occasions, embracing not only our most intelligent yeomanry, but members of every art and profession, from all portions of the wide-spread Union, and thus disseminated correct information in regard to the institutions of each portion of the country among the people of the other portions.

At these national jubilees, gentlemen have met upon the broad platform of good citizenship, merging all sectional jealousies and party distinctions in a general desire to improve and to elevate that great calling which gives independence and strength to our nation.

Agricultural discussions and addresses, both at the "evening meetings," the banquets, and on the grounds, have formed a prominent feature in the proceedings.

The recent exhibition at Chicago, whether we regard its magnitude or excellence, was eminently worthy of a great agricultural nation.

The number of articles entered for exhibition was 2,549, classified under 123 separate departments, beside that of miscellaneous articles, and coming from the following States: California, Georgia, Connecticut, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland,

Massachusetts, Michigan, Minnesota, New Hampshire, New York, Ohio, Pennsylvania, Texas, Virginia, Vermont, and Wisconsin, and the Province of Canada. Delegations were in attendance from eighty-one societies, embracing twenty-seven States and Territories.

The leading feature of the exhibition was the trial of steam plows, for which the society had offered its highest prize—the grand gold medal of honor.

The large premiums offered by the Illinois State Society, and the Illinois Central Railroad Company, were also awarded at this fair, and the trial was conducted by committees appointed by each.

The report contains an able review of the trials in England and America, and shows the superiority of the American plow invented by J. W. Fawkes, of Lancaster, Pennsylvania.

During the entire week both the city and extensive fair grounds were crowded to their utmost capacity.

It was truly a national gathering, and a fitting occasion for the commencement of official courtesies between the national societies of England and America. In reply to an invitation from President Tilghman, on behalf of the United States Agricultural Society, the following letter was received from the Hon. Thomas de Gray, Baron Walsingham, President of the Royal Agricultural Society of England:

"SIR: I beg to acknowledge the receipt of your letter containing an invitation to the exhibition of the United States Agricultural Society, to take place at Chicago.

"I regret much that, your letter having only just reached me, the great distance will prevent my being present at a meeting in which I should feel the greatest interest.

"I shall report your obliging communication to the council of the Royal Agricultural Society of England, and feel certain they will feel, as I do personally, much gratified by the honor you have done them in inviting their President to your exhibition.

"I have the honor to be, sir, your obliged and obedient servant,

"WALSINGHAM,

"*President of Royal Agricultural Society of England.*

"General TENCH TILGHMAN,

"*President United States Agricultural Society.*"

It is an interesting incident in the history of these two great agricultural nations, that the present mode of conducting their national fairs was commenced almost at the same period, and has been attended with results which evince a remarkable degree of coincidence.

The Royal Agricultural Society of England, however, had been in successful operation for many years, sustained by the wealth and enterprise of that powerful and enlightened nation, before it ventured upon the experiment of migration in its fairs, which has since been found to be so highly beneficial in its results.

It is still regarded as an undertaking of no ordinary magnitude; and yet the actual extent of their migrations is less than those of the State Agricultural Society of New York, whilst the shortest distance between the locations of any two consecutive fairs of the United States Agri-

cultural Society has been greater than the entire extent of the United Kingdom of Great Britain.

The principal difficulty encountered in both countries has been in securing the attendance of competent and experienced judges, especially in the machine and implement departments. This has been obviated in England by the payment of their expenses, and it is hoped that the United States Agricultural Society will soon have sufficient capital to enable it to adopt a similar course.

Seven volumes of transactions have been published, containing reports of the annual meetings, exhibitions, and operations of the society, with a general statement of the position of agricultural affairs at the metropolis, (including such information as is furnished by the Agricultural Division, and by the examiner of implements in the Patent Office,) and reports of the operations of State boards and societies, agricultural colleges, and of all legislative recognition of the predominant interest of the country.

This publication is now issued in four numbers, as the *Quarterly Journal of Agriculture,* and edited by the secretary of the society.

Avoiding all intrusion upon the legitimate sphere of the various agricultural periodicals, it affords an opportunity for those most deeply versed in the arcana of nature to discuss those abstruse principles from which the most important results are often found to proceed.

A secretary's office, library, and reading-room have been established at Washington city, where the members of the society, and others interested in agricultural improvement, meet as brothers at a common home, and find a collection of objects in which they have a common interest.

Many State and county societies have contributed their published transactions, premium lists, the names of their officers, and other information, which has been duly registered, and they have received the publications of the society in return.

A majority of the agricultural and numerous other publishers have contributed their periodicals and newspapers, and thus aided in forming a free agricultural library.

As soon as sufficient means can be obtained, either by endowment, appropriation, or otherwise, it is proposed to establish at Washington an experimental farm, where every species of culture, all the products of the soil, and the different varieties of domestic animals, may be seen by every one who visits the national metropolis.

The society is supported by fees for membership, and by the proceeds of its exhibitions.

Life-members receive an elegant diploma, all the publications, free tickets of admission to all exhibitions, and their share of such seeds and cuttings as may be procured for distribution, without any additional assessment or payment beyond the admission fee of ten dollars.

Annual members receive the publications of the society, paying a fee of two dollars.

County or town societies have the privilege of making their president, secretary, or treasurer, *ex officio,* a life-member, in which case the society will receive the publications, &c.

The increased interest in the annual meetings and exhibitions of the society, and the constant additions to its roll of members, furnish evidence of its growing prosperity and usefulness.

Its present officers are as follows:

President—Tench Tilghman, Oxford, Maryland.

Vice Presidents—N. B. Cloud, Alabama; S. Mowrey, Arizona; H. A. Dyer, Connecticut; A. W. McKee, California; John Jones, Delaware; W. W. Corcoran, District of Columbia; A. G. Fuller, Dacotah; S. R. Mallory, Florida; Richard Peters, Georgia; D. P. Holloway, Indiana; J. A. Kennicot, Illinois; Legrand Byington, Iowa; W. L. Underwood, Kentucky; W. F. M. Arny, Kansas; J. D. B. DeBow, Louisiana; John Brooks, Massachusetts; N. N. Harrison, Mississippi; A. Kimmel, Maryland; H. Ledyard, Michigan; E. Holmes, Maine; H. M. Rice, Minnesota; J. R. Barrett, Missouri; H. F. French, New Hampshire; J. H. Frazee, New York; B. P. Johnston, New York; Miguel A. Otero, New Mexico; W. T. Brown, Nebraska; H. K. Burgwyn, North Carolina; F. G. Cary, Ohio; Joseph Lane, Oregon; A. Clements, Pennsylvania; E. Dyer, Rhode Island; F. W. Alston, South Carolina; Thomas Affleck, Texas; D. R. Eckels, Utah; Frederick Holbrook, Vermont; W. A. Spence, Virginia; D. S. Curtis, Wisconsin; I. I. Stevens, Washington Territory.

Executive Committee—T. Tilghman, *ex officio*, Maryland; Marshall P. Wilder, Massachusetts; H. Wager, New York; J. McGowan, Pennsylvania; Frederick Smyth, New Hampshire; J. W. Ware, Virginia; J. Merryman, Maryland; Horace Capron, Illinois; J. M. Cannon, Iowa; B. Perley Poore, Massachusetts.

Treasurer—Benjamin B. French, Washington, District of Columbia.

Secretary—Ben. Perley Poore, Newburyport, Massachusetts.

During the first five years of the existence of the society, the venerable George Washington Parke Custis, the vice-president for Virginia, and the last surviving member of the family of Washington, was a regular attendant at its annual meetings.

He had been among the earliest and most steadfast advocates of a national agricultural society, having, as early as 1810, published in the National Intelligencer, and also in pamphlet form, a *projet* for a national agricultural organization, to be incorporated with the government and attached to a national university.

He had always been requested by President Wilder to conclude the proceedings; and his valedictory at the fifth annual meeting (the last before his death) is replete with sentiments which are worthy of one who was so nearly connected with the author of the *farewell address*. It terminates with the following patriotic appeal:

"The time has come for me to say *farewell!* And when a man on whose head rest the snows of seventy-six winters bids you farewell, the probabilities are that it will be a long farewell.

"You will now return to your homes, with hearts cheered and hands strengthened by this mutual communion, and this brotherhood of farmers from all parts of our great country.

"And as you come up from all portions of the country, from these classic grounds where our fathers died, let your hearts be invigorated by their patriotism, and your hands labor for the prosperity of the country they bought with their blood.

"And now, gentlemen of the United States Agricultural Society, farewell! Go back to your homes, and tell your friends what has been done at this meeting for the cause of agriculture, and encourage them as you have been encouraged.

"Continue your devotion to this bulwark of our country; continue inviolate our great Constitution; obey our self-imposed laws; preserve our blessed Union, and our republic will be immortal."

NATIVE GRAPES OF ARKANSAS AND TEXAS.

BY H. C. WILLIAMS, OF JEFFERSON, CASS COUNTY, TEXAS.

The Patent Office having decided to "make a thorough experiment with our native grapes," to test their merits for wine and table use, I received instructions, dated July 1, 1857, directing me to proceed to Arkansas, and explore portions of that State, Texas, and the adjacent Indian territory, as far as practicable, to inspect the vines while in fruit, and to obtain certain information connected "with their growth and locality, to be employed in carrying out said experiment." After making those observations, and at the proper time, I was directed to collect cuttings of the vines, to be forwarded to such points as might be designated in future instructions.

Accordingly, I left the city of Washington on the 1st of August following, and proceeded by the most direct route to the Hot Springs, in Arkansas, the first point where the wild grapes are found in such abundance as to invite attention. At that place, with so many attractions to the naturalist, I spent several days, and made frequent short excursions in the mountain ridges and hills of the neighborhood. From the foot to the summit of those ridges, some of which are beds of *novaculite*, or the celebrated Arkansas oil-stone, two varieties of wild grapes are found in abundance. I was disappointed in one of the objects of the mission, that of observing the "fruit on the vines," for the frosts of the preceding April had almost entirely destroyed the crop, wild and cultivated, throughout the State. A few chance branches had escaped, and I found a native vine in the garden of Mr. Fullerton, with fruit on it, which enabled me to ascertain the varieties. These will be hereafter designated.

While at the Hot Springs, I learned from Mr. Whittington, a resident of the village, that he had some years previously collected a quantity of the wild grapes "from the hills," and expressed the juice with the view of making vinegar for family use. The following spring, finding the *wine* of such fine quality, he drew off about five gallons and set away the vessel containing it in a garret room in his house. There it remained undisturbed for two or three years. A guest from Little Rock, who had been a dealer in wines, being informed of the experiment, requested an examination, and decided that the wine was a first-rate claret.

Resuming my journey, I proceeded to Hempstead county, where I learned that the frosts of the preceding spring had been more severe than in any portion of the country I had traveled over. Not only was the fruit crop entirely destroyed, but the ornamental trees, in many instances, were killed to the ground. The forest trees, especially the oaks, had suffered severely. As it would have served no beneficial object to continue explorations, I determined to proceed no further, but devote the interval of time, before commencing to take off cuttings, to an examination of the portions of the counties of Hempstead and Sevier in which the native grapes are found, and to collect such information regarding them as the Office desired. Other obstacles presented themselves; a long-continued rainy season had set in; the streams became impassable; the mail failed in many of its trips; and nearly all travel was suspended, until the time of the ripening of the grapes was over. Beside, I had an attack of chills and fever, which were more prevalent then than they had been for many years previous.

Having waited until the first of November, I set out with a light two-horse wagon, in which boxes were placed to contain cuttings, and took a northerly direction, expecting that the first frosts of the season would be met in the mountains. The 8th of that month there was a killing frost, when I was in the Washita cove; and, in a day or two after, the vines were in a condition to admit of cuttings being taken. As I had anticipated, the roads in the mountainous country were not much traveled, and their condition was but indifferent. I performed most of the journey on foot, and had ample time to select cuttings from the vines on the way-side, and keep up with the wagon. In this way I passed through the counties of Sevier, Polk, Scott, and Franklin, as far as Mulberry river, where high waters prevented further progress. The country over which I traveled was generally mountainous, the spurs or ridges rising about eight hundred or a thousand feet above the plain; and, in one or two places, the boiling point of water indicated an altitude of eighteen hundred feet. This elevation can only be regarded as approximately ascertained. The prevailing rocks of the mountain ranges were sand-stones, and the soils resulting from them, of course, very silicious. The valleys are generally narrow, washed by the rivers and mountain streams. The prairie lands of Franklin county seemed to be connected with the sand-stone of the coal formation. Bituminous coal, of excellent quality, is mined in many places. The timber on the sandy soils is generally post oak, black jack, and nutmeg hickory; and it is worthy of special remark that the most extensive grape thickets are always associated with sandy soils where those trees are abundant. On high lands, termed the black-jack ridges, and distant from the settlements, where the woods are seldom burnt, the grape vines flourish with greatest luxuriance. Before leaving Washington, I had been informed by a gentleman who had resided in Arkansas, that I should be certain to find the white grape near Pleasant Hill post office, in Franklin county. Of this grape I could gain but little reliable information in the southern part of the State, where the citizens are mostly engaged in cotton planting, and scarcely cultivate fruit of any kind. This variety was first obtained in Scott county, where its singular appearance, in contrast with other vines,

attracted notice; but the larger portion was procured on the farm of Mr. Bryant, near Mulberry river.

Finishing the collection at this point, I returned to the town of Ozark, recrossed the Arkansas river, and proceeded to the west, to reach a point of the Grand Prairie, where I was informed that I should find the white grape vines in abundance. In this I was disappointed. After passing Waldron, I took the road which led to the Hot Springs, passing near the town of Mount Ida, in Montgomery county. Through the whole distance, the same general features marked the soil and productions which had been observed on the journey to the Arkansas, with the difference of occasionally presenting large groves of pine on the summit of the hills, with which the native grapes were closely associated.

After having made a collection at the Hot Springs, I took the road through the Caddo Cove, passing into Pike county, and through it to the starting point in Hempstead county, which was reached on the 14th day of December. As on the previous part of the route, I continued to make collections along the roadside, with a view of procuring all the varieties of native grapes. That course only was left open to me, as I had been disappointed in seeing the fruit on the vines; and to be certain of getting all, I determined to make as extensive explorations as the season would permit.

In the collection thus made at random it cannot be pretended that any accuracy could be observed in designating varieties by labels. No reliable information could be obtained from the inhabitants, and the most careful observers among them would only say "in a grape year the fruit could be gathered by the wagon load; that the grapes were the best they had ever seen, and were as large as the end of their finger or thumb." Therefore, in packing the cuttings I designated the collection as "Mountain," "Red River," and "Washita," from the circumstance that these varieties, growing together, are, nevertheless, more numerously multiplied in those localities. When they produce fruit they will be easily distinguished, and I propose that the names be continued.

The variety to be called the "Mountain" is found most abundantly on the silicious soils of the elevated country; though, in some portions of Sevier and Pike counties, it is often met in the light, loose, dry soils of the tertiary formation. As we approach Red river it becomes scarce, and is apparently superseded by the variety proposed to be called by that name. Allied to the species known to botanists as the *vitis æstivalis*, it is probably a sub-species. The growth is strong and vigorous, often short-jointed, with deeply colored bark near the joints. The branches are short, thick, very compact; and the berries as large as a medium size Catawba, covered with a bloom. The color is black. It begins to ripen about the middle of September, but the bunches will hang on the vines till winter. The skin is about the thickness of the Catawba, and the pulp reddish. In Arkansas, I learn that raisins of good quality had been made from it. With the amelioration which cultivation will doubtless produce, this will be a valuable grape in southern locations.

The "Red River" is also allied to *vitis æstivalis*. In its characteristics there is some resemblance to the preceding, but in general the

vine is not so vigorous in its growth, the bark a paler red and brown, and the fruit inclining to black, but not so deeply colored. The bunches are open, loose, and shouldered; skin thin, pulp reddish and more juicy than the "Mountain." Its flavor is sweet and sugary. From these grapes Mr. Whittington made the wine before alluded to

When these varieties grow in shaded positions the extremities of the vines do not thoroughly ripen the wood for several joints back from the extremities, and the following season the buds on the ripened wood vegetate and take the same course as the growth of the former year. This condition in the growth for a few years gives the vine a bush form; and hence the common expression in Arkansas of the "bush grapes," or that the grapes grow on low bushes. The vines are, however, runners, where there is anything for them to clamber upon; but they never attain the large growth of the common summer grape-vine.

The "Washita" was occasionally found on the road from the Arkansas river to Hempstead county. It was first discovered on the Washita river, hence its name. Probably it is a species of fox grape, the *vitis labrusca* of the botanists. The vine is a vigorous grower, of a rusty-brown color, and the wood more soft and spongy than any other variety of grape. Having never seen the fruit, I can only give such description as I received from various sources, selecting those points on which there is no disagreement. All unite in assigning it high merit as a juicy, sweet grape, with a foxy aroma. The skin is thin, and the berries large. When fully ripe it varies in color, but is generally a light brown, or tinged with brown; while growing it is remarkably transparent and of a light greenish hue. Its period of ripening is earlier than other wild grapes, and so eagerly is it sought by birds, that it is exhausted before the neighboring planter is aware that it is ripe. Hence, it is not unusual to find persons who have resided in its midst for many years, yet who have no knowledge of its existence. Besides, it grows on the richer soils bordering the streams, and is, therefore, more likely to be destroyed as the lands are cleared and put under cultivation. Though preferring a rich, deep, alluvial soil, it is not a tenant of low, damp grounds.

Believing this to be a new and superior variety, and one that would be an acquisition to the wine-maker, I determined to spare no exertions to obtain it. This was the reason of my making such an extensive excursion. As far back as the year 1842, which I spent in Arkansas, my attention had been called to this variety by the late General Towson, United States army, though all my efforts to procure cuttings for him were unsuccessful. He was of opinion that it was the grape to which Colonel Long alludes in his expedition to the Rocky Mountains. It is said that the late Mr. Audubon had seen it on the Red River, and had pronounced it equal to any French variety. While on my excursion, I met the late Hon. Shelton Watson, judge of the circuit court, who assured me that this grape had been taken to France, and there had established a reputation for the highest excellence. In the town of Ozark, a very intelligent gentleman, the treasurer of the county, informed me that he was from the Rhine, was acquainted with the grapes grown in the wine countries, and "he did not believe a finer grape than

the Washita could be found in the United States or Europe." Perhaps his encomium may appear extravagant, but still his intelligence and powers of observation entitle his opinions to high regard.

I learned that several experiments in making wine had been attempted in Arkansas. Some years since, a prominent member of a temperance society made a barrel of wine, which act being considered a breach of its rules, he was cited to trial, convicted, and sentenced to make two barrels more the next season. Whether he complied with the sentence I am not able to state; but this much I feel bound to say, that if more attention were paid to the cultivation of the grape in Arkansas, much of its soil, unsuitable for cotton or grain crops, and regarded as comparatively valueless, would be as productive as the best cotton lands. So many varieties of fine grapes were not placed there by Nature without some beneficent object, and but energy and skill are required to bring out that object, and open new avenues to industry and wealth.

The mountainous region is proverbial for its health, the atmosphere pure, streams of water abundant, and the scenery, for beauty and sublimity, unrivaled. Sheep raising, where there are so many nutritious grasses, affording good grazing nearly the whole year, could be made a profitable business, and might be connected with vine culture.

In this place it may be proper to mention, that on the streams in the lower part of the State, the bottom lands are literally covered with muscadine vines, (*vitis vulpina.*) They vary in quality, and some of them, no doubt, would prove as good for wine as the Scuppernong of North Carolina. I did not learn that any experiments in wine-making from them had ever been made, but as an inducement to the trial, I will state that Mr. Longworth informed me that he would purchase, at a fair price, as much wine of those grapes as might be sent to him. He wished to obtain it to be used in flavoring his Catawba. The desideratum of American wine grapes, in his opinion, consists in their imparting the foxy aroma to the wine, a realization of which I entertain the most sanguine hopes in the successful cultivation of the Washita.

Having laid away the cuttings in sand, to preserve them until the collection should be complete, and having rested the team, I again set out, on the 30th of December, 1857, with a view of ascending the Red River as far as the Cross Timbers. In the condition of the roads at that season it was thought advisable to proceed through the Choctaw Nation, by Fort Towson, cross the river near the mouth of the Kiamechi, take the main road leading through Paris, Bonham, and Kentucky Town, and strike the Cross Timbers south of Preston. A great portion of this journey was through a prairie country, of a rich, black, calcareous soil, in which grape-vines are very seldom seen. In the pine lands, from the Arkansas line to Wheelock Academy, where the prairie is reached, similar grapes to those already collected are found; and likewise, in the red-oak lands, from the ferry on Red River to the town of Paris, there is great abundance of that variety proposed to be called "Red River." On my return by another route, through the timbered lands adjoining the prairies, it was of frequent occurrence, and very abundant in the Cross Timbers, where the soil is arenacious, and the prevailing rock a sandstone, probably belonging to a coal

formation subsequent to the carboniferous period. The collection at that point was marked for the locality, in hopes that the varieties would be established when the cuttings produced fruit. A gentleman long resident in the Cross Timbers informed me that three varieties were common there.

Near the Cross Timbers, a Mr. Simcoe politely conducted me to a place where I obtained all the cuttings designated as the "Mustang." The general appearance of this vine resembles the muscadine, except the bark of the old wood inclines to detach itself in strips, like Catawba and other vines. It was described to me as a great runner, reaching the tops of the tallest trees, and to be a profuse bearer. In some portions of Texas it is multiplied to an extent almost incredible to a person who has never visited that State and who knows but little, except by report, of its extraordinary natural productions. I hazard nothing in saying, that if all the mustang grapes were made into wine, and sold at one dollar a gallon, the product would greatly exceed the value of a cotton crop. The chief excellence of this grape consists in its qualities for making wine, as the skin contains such acrid matter that the fruit cannot be eaten, without producing painful sensations to the inner coats of the mouth, and sometimes swelling. The skin must be broken, and the pulp withdrawn, which is said to be exceedingly sweet and juicy.

On my return from the Rio Grande, in March last, Dr. J. H. Lyons, of San Antonio, presented me with ten bottles of mustang wine, made the previous season from the wild grapes. Those bottles were distributed among the friends of native grape culture, by some of whom it was pronounced a good claret, wanting only age to bring out its qualities. One gentleman, not less distinguished as an agriculturist and friend to native vine culture than for his eminent talents and public services, remarked, in relation to the bottle sent him, that "the mustang wine has had so bad a chance from traveling so far and so recently that a proper judgment cannot now be passed on it. I regret that I did not let it rest two or three months, which is little time enough for it to settle after its travels. It would be pronounced common claret, a little pricked, by most persons. I still think, however, that I perceive in it the elements of a rich and highly-flavored claret; but as to its delicacy, whether it turns out Pineau or Gamay, no opinion can be formed from this bottle, under the circumstances."

It was not until the 8th of February that I returned from this trip, and immediately commenced arrangements for leaving the country with the collection. Being delayed in the means of transportation, I did not reach New Orleans until the 4th of March, and proceeding up the river to Memphis, I then forwarded suits of the cuttings to the different points designated in my instructions.

EL PASO GRAPES, OR GRAPES CULTIVATED ON THE RIO GRANDE.

The Patent Office having determined to continue the collection of American grapes, and wishing to obtain seeds and cuttings of those cultivated at Paso del Norte, in the department of Chihuahua, I engaged to make the collection in the manner agreed upon, and set

forth in instructions, dated July 1, 1858. By those instructions, I was directed "to proceed to Santa Fé, in New Mexico, *via* Independence, Missouri, and explore the valley of the Rio Grande as far below El Paso (in Texas) as the grape season would admit." On my arrival in the valley of the Rio Grande, I was to "take the requisite steps to procure cuttings preparatory to their removal," "noting the character of the fruit, the local names, their period of maturity, the nature of the soil," and any "information connected with the climate, which would have a bearing on the case." I was also required "to collect small quantities of grape seeds, and forward them to the office by mail." In case I "met with ripened seeds of any other valuable native wild fruits, forest trees, or shrubs, or any important vegetables, which could be conveniently collected," I was instructed "to put them up in a proper manner, and forward them to the Office." It was stipulated that this duty should be performed in a "period of nine or ten months, commencing the 1st day of July, 1858," and for which I was to receive a fixed compensation.

Having made the necessary preparation for the journey, I left Washington city on the 14th day of July, and proceeded directly to Independence, Missouri, arriving there in time to secure a passage in the mail train, which left on the 19th, for Santa Fé. The journey over the plains was accomplished without delay or accident, and I reached Santa Fé on the 8th of August. As the grape season did not, as I then learned, commence before the last of August, I did not think it necessary to proceed to El Paso by the mail stage which left for that place on the 11th of August, but remained there until the departure of the mail on the 25th, and reached El Paso on the 1st day of September.

In the market of Santa Fé I found excellent plums. They resembled the wild variety known in the southern States as the Chickasaw, though more sweet and delicious than southern plums. Apricots, also, were in season. In comparison to our improved sorts, they were small in size, but in richness of flavor are not surpassed. Seeds of these fruits were collected and sent to the Office. So far as I could learn, these fruits are grown in a natural way, the art of budding and ingrafting being unknown to the natives, or not practised. The trees are chance seedlings, or transplanted suckers, and thrive most when in proximity to the *acequias*, or irrigating canals, from which the roots derive a constant and regular supply of moisture. I saw no orchard in New Mexico, though with irrigation, apples, pears, and peaches could be successfully cultivated. I did not see any of those fruits which would be considered valuable where our varieties are known.

Descending the Rio Grande, the vineyards are first seen at Bernalilla. At Albuquerque, I learned that the grape was extensively cultivated. I was told that the fruit from cuttings procured in Paso del Norte was of inferior quality, but that another generation of vines produced grapes equal to those grown three hundred miles south. How far this is to be received as correct, I had no means of ascertaining, but, as it seems to favor the idea that the habituation of these grapes to a northern latitude is gradual and progressive, I deem the statement necessary, leaving future experiment to test the principle.

The grapes which I saw in Albuquerque were of such excellent quality that every inducement is held out to increased cultivation.

The vine is cultivated in many if not all the villages on the Rio Grande, though not so extensively as at Paso del Norte. The vineyards there are scattered through the town, wherever water can be procured for irrigation. They are generally small, inclosed by adobe walls, and resemble in appearance the inclosures devoted to the growth of culinary vegetables in the lesser towns of the United States. Great quantities of the fruit are exposed in the market places, and much is dried for winter use.

As yet there are but few vineyards in El Paso valley, on the eastern or Texas side of the river, but the market was abundantly supplied from the vineyards in Paso del Norte. There are but two varieties, the *white* and the *blue*, though some of the proprietors of the vineyards will say that there are *five or six classes*. Their distinctions, however, are founded merely on variations in color, caused by different exposures to light, and it not unfrequently happens that two or more classes are taken from the same vine.

The *white* grape was nearly out of season when I arrived at El Paso. The bunches are large, loose, and shouldered. The berries are about the size of the Catawba; they have scarcely any pulp, very sweet and juicy, with a slight and not unpleasant musky aroma, which is imparted to the wine. This is of a pale straw color, slightly acid. The vine is vigorous, but does not seem to be hardy.

The *blue* grape, which this year was in season from the 25th of August till the 15th of September, is more extensively cultivated in Paso del Norte. The bunches are large, loose, and branching, sometimes weighing three pounds; and as many as thirty bunches have been picked from a single vine. Such a yield is, however, unusual, though with better cultivation than is now given the product would be augmented. The berries are generally larger than the Catawba grapes of our vineyard, thin-skinned, very juicy, and exceedingly sweet. The vine is short-jointed, and a strong and vigorous grower. When in the vicinity of fruit-trees on which they can climb the vines will sometimes grow twenty feet in a season. Such vines are, however, not productive, and it is probable that if they were trained on frames they would not be so fruitful nor of such fine quality as cultivated by the present mode.

The vineyards of Paso del Norte are planted in rows, five or six feet apart each way. Most of the labor of the vineyard is performed with the hoe, while the ground is kept loose by frequent irrigations. If the ground were to receive stirring once or twice by the plow, it would certainly be attended by beneficial results. It would have a tendency to lessen irrigation, which, in my opinion, is overdone, and, as a consequence, the energies of the vine are expended in the production of wood. The vines are lopped off in a very careless manner, and a stump two or three feet high is formed. The bearing branches emerge from the buds near the top of the stump; these are annually cut back to three or four buds, every spring; but it is often done so late in the season that the flow of sap kills the spurs, and suckers are thrown out from the roots. Early in winter, the branches are drawn together and

bound; the earth is then heaped around the vines with a hoe, in which condition they remain till the following spring, when danger from frosts is supposed to be past, and the vines are headed back, and the earth leveled. It would no doubt be an improvement on the present system if the vines were pruned before the winter protection is given them, and the spurs covered with earth. Great injury is done by straining the vines and rupturing the sap-vessels in the operation of gathering up and pruning in the spring. The pruning should always be done with hand shears. An impression prevails among the vineyardists that pruning in early winter is prejudicial to the vines. Nothing can be more absurd; for the drying of the end of the vine where pruned off would prevent "bleeding" when the sap is in motion the following spring. From this notion being generally entertained, I had great difficulty in obtaining cuttings.

Major Emory, in his able "Report on the Mexican Boundary Survey," says:

"Southern California, the whole of the upper valley of the Gila, and the upper valley of the Del Norte, as far down as the Presidio del Norte, are eminently adapted to the cultivation of the grape. In no part of the world does this luscious fruit flourish with greater luxuriance than in these regions, when properly cultivated. Those versed in the cultivation of the vine represent that all the conditions of soil, humidity, and temperature, are united in these regions, to produce the grape in the greatest perfection. The soil, composed of the disintegrated matter of the older rocks and volcanic ashes, is light, porous, and rich. The frosts in winter are just sufficiently severe to destroy the insects without injuring the plant, and the rain seldom falls in the season when the plant is flowering, or when the fruit is coming into maturity and liable to rot from exposure to humidity. As a consequence of this condition of things, the fruit, when ripe, has a thin skin, scarcely any pulp, and is devoid of the musky taste usual with American grapes." (I differ with Major Emory, it will be seen, in regard to the musky aroma of the white or *muscatel* grape, as it is sometimes called. He doubtless refers to the *blue* grape, of which most of the El Paso wine is made.)

"The manufacture of wine from this grape is still in a crude state. Although wine has been made for upward of a century in El Paso, and is a very considerable article of commerce, no one of sufficient intelligence and capital to do justice to the magnificent fruit of the country has yet undertaken its manufacture. As at present made, there is no system followed, no ingenuity in mechanical contrivance practised, and none of those facilities exist which are usual and necessary in the manufacture of wine on a large scale; indeed, there seems to be no great desire beyond that of producing as much alcoholic matter as possible. The demand for strong alcoholic drinks has much increased with the advent of the Americans; and in proportion as this demand has increased, the wine has decreased in quality. On one occasion, I drank wine in El Paso which compared favorably with the richest burgundy. The production of this wine must have been purely accidental, for other wine made of the same grape and grown in the same year was scarcely fit to drink."

The process of making wine is quite primitive. The great scarcity of timber in that country compels a resort to various means to supply its place, and none is more likely to arrest attention than that which takes the place of the wine-press. An ox hide is formed into a pouch, which is attached to two pieces of timber and laid on two poles supported by forks planted in the ground-floor of the room in which the vintage takes place. The grapes are gathered in a very careless manner, and placed in the pouch until it is filled. They are then mashed by trampling with the feet. In this condition the mashed fruit, stems, and some leaves remain until fermentation takes place, which requires from fifteen to twenty days. An incision is made in the lower part of the pouch, through which the wine drips; it is transferred to barrels. The wine now has a flat, sourish taste. Should it be desired to make sweet wine, grape syrup, made by evaporating fresh juice, is added until the wine has the desired sweetness. It is not afterwards fined, or racked off, but remains in the cask until used. Perchance a few bottles may be filled and set away for particular occasions, but a very small quantity remains on hand six months after it is made. The scarcity of suitable casks, and the high price of bottles, may be a reason of so little old wine being in the country. I was told that the wine never underwent a second active fermentation. The room in which the wine is made and afterwards kept resembles a cellar, except that it is above ground, always dry, and an evenness of temperature preserved by thick *adobe* walls and a covering of earth.

For the last several years there has been a falling off in the product of the vineyards. The estimate is from two hundred and fifty to three hundred gallons to the acre, but with American skill in the management of the vineyards, and American appliances in making wine, the product might be more than doubled. The El Paso valley, on the Texas side of the Rio Grande, is about eighty miles long, and has an average width of seven or eight miles. This, in my opinion, is the Eden of the grape in the United States. The whole of this tract of country is adapted to vine culture. In some portions of California the same grapes which are cultivated on the Rio Grande may be produced in greater quantities to the acre, and the bunches and fruit may be larger; but it should be recollected that the grapes of California are cultivated with superior skill, and perhaps the soil of the vineyards in that State has not been so long under cultivation as that at Paso del Norte. Still, I think, in the quantity of grapes produced, and their qualities for wine, the El Paso valley will not, when it has a fair trial, be excelled by any district in California. As yet, lands in the valley are cheap; the town of San Elizario, the seat of justice of El Paso county, has a large body of land, which it will part with at a nominal price to actual settlers. The village of El Paso, near the upper end of the valley, has in a few years become a place of considerable trade. That point may now be said to be the key to the trade of Arizona and northern Chihuahua. It is the point where the two great overland mails have to pass, and is near the place which Nature has marked out as the most eligible for a railroad to the Pacific, to cross the Rio Grande.

The soil of the El Paso valley is an alluvial deposit, obviously de-

rived from the volcanic and older rocks of the mountain ranges. It is of a brownish color, absorbs water freely, and when duly saturated, is open and porous. The roots of vegetables penetrate it very easily. Beneath the surface there are thin beds, or strata, in which clay predominates. These beds contain a substance called "*salitre*," probably a mixture of alkaline matters. Salitre is often found on the surface, in thin efflorescence, especially in places from which water has subsided. The water of the Rio Grande, no doubt, holds it in solution, more especially after the rainy seasons, and as long as it is used for purposes of irrigation, the alkalies cannot be exhausted from the soil. The presence of the alkalies must, doubtless, be very energetic in supporting the luxuriant vegetation of the valley, as well as the principal means of continuing its wonderful fertility without apparent exhaustion. It may be proper in this place to remark, that the grape evinces a preference for the soils which are inclined to be sandy, and the most flourishing vineyards in Paso del Norte are those on the sites where the sand has been settled by the winds. The soil is admirably suited to the growth of corn, wheat, cotton, and tobacco; garden vegetables are raised in profusion.

The El Paso valley is remarkable for the production of various kinds of fruits. The apple, pear, quince, peach, almond, fig, pomegranate, and Persian walnut, also the apricot and plum, though not extensively cultivated, succeed well; but as the late improved sorts of our gardens and orchards have not reached that country, their fruits cannot be compared to ours. Exceptions can be made only of the grape, the fig, and the quince, which in quality are not excelled in the Atlantic States. Advantage is taken of the facilities for drying fruits, and immense quantities are thus preserved every year. In making *pasas*, or Mexican raisins, the largest and best bunches are taken from the vines when fully ripe and hung up in the houses. The grape gradually shrinks away until it becomes skin and seeds, with a small honied consistence surrounding the seeds. Fearing that a quantity of seeds which I had purchased might have their vitality injured by the dryness of the atmosphere before I could send them to Washington, and believing that the honied consistence round the seeds would serve as a protection, I purchased about fifty pounds of the dried grapes, and reported the fact to the Office. I regret that the letter approving my course, and directing a further purchase, did not reach me in time to comply with the order to the desired extent, but through the exertion of my obliging friend, Mr. Lightner, an American merchant residing in Paso del Norte, I obtained an additional *almo* and a half. Señor Don Joachin Sabo, of Paso del Norte, presented me with a gallon of seeds, and I also sent some of those I had purchased, and am gratified to learn that, with all, the success has been most complete, and the crop raised in the propagating gardens is worth a far greater sum than was expended in introducing them. Of the ultimate success of these grapes, especially in the southern States, I have not the least doubt, and I do not think experimenters should be discouraged if the first results do not equal their expectations. Dr. Lyons, of San Antonio, Texas, informed me that he had a vineyard of two hundred and fifty vines of the El Paso grapes, which would come into bearing next or the follow-

ing year. From his intelligence and skill, and the lively interest he takes in grape culture, the friends of "the cause" may look for most favorable results. The San Antonio river will afford water for irrigation, and the flourishing city of that name on its banks will furnish every convenience and facility for making and storing wine. The country round that city holds out inducements to grape culture, and the vine will no doubt succeed well on the Picos and other streams between that point and the Rio Grande, where water can be had for irrigation. On Devil's river I was told that wild grapes are found of such excellence that some persons maintain that they are indentical with the El Paso grapes, but that is a mistake, for those grapes are of European origin.

There was no frost last year until about the middle of November, and then so slight that the vines were not in a condition for cuttings to be taken off until the last of the month. From the objections before alluded to, I experienced much difficulty in procuring cuttings, and for those obtained I am indebted to the politeness of Señor Don Guadalupe Mirandi, Señor de Oranga, and Mr. Lightner. On the 10th of January I had the collection packed and ready for conveyance to Washington, but was detained till the 8th of February before a train passed down to San Antonio. We were thirty days making the journey to that place, a distance of six hundred and fifty miles. The collection reached New Orleans, and was sent on to Washington the 28th of March, 1859. The journey was accomplished without loss or injury to the collection, except that, in following my instructions to pack the collection in barrels made air-tight, I found one barrel of cuttings so much injured, on reaching New Orleans, that they had to be thrown away.

I did not explore the country below El Paso during the grape season, for the reason that the vine is cultivated to a limited extent east of the Rio Grande, and I should not have met with any native varieties until reaching Devil's river, by the mail, which then made but semi-monthly trips. That place is in an uninhabited part of the country, and in the midst of the Apache Indians. Such was then the condition of affairs on the border that the government established additional military posts, one of which is in the El Paso valley. I collected seeds of the piñon, or *Pinus edulis*, mezquit tree, tornillo, sapindus, seeds of several vegetables, and some superior wheat, cultivated by the Pimos Indians, which were forwarded by mail.

REPORT ON THE SACCHARINE CONTENTS OF NATIVE AMERICAN GRAPES IN RELATION TO WINE-MAKING.

BY CHARLES T. JACKSON, M. D.

Wine is properly the fermented juice of grapes, and contains alcohol, variable proportions of grape sugar, bi-tartrate of potash, and some tartrate of lime, with a very little malic and tannic acids, and some mucilagenous matters, besides oenanthic acid, and in old times oenanthic ether and some volatile oils, derived from the grapes or produced by fermentation.

The tartrates are characteristic of the wines produced from the grape, and do not characterize fermented currant, gooseberry, or apple juices; citric acid being contained as the chief acid of the currant and gooseberry juice, while malic acid is that of the juice of the apple. Currant and gooseberry juices, therefore, are not wines, but are similar to punch made of lemon juice and alcohol, sweetened. Fermented apple juice is not a wine, for it does not contain the tartrates, nor any tartaric acid, but does contain malic, acetic, and tannic acids. If we intend to produce wine we must resort to the juice of grapes exclusively, and it therefore becomes important to inquire if the native American grapes will produce good wines. The object in the present analysis is to ascertain the most important facts bearing upon this subject, and although the limited researches, extending only through one season, may not fully settle the question, we trust that they may throw some light on the subject, and open the way to more extended researches.

It was obvious at the outset that we must find out the proportion of saccharine or alcohol-producing matter in the American grapes; for if they will not produce alcohol in sufficient proportions to keep the wine from souring, we should have to add saccharine matter in some other form to make a sound wine If the acids in our grapes are not the same as those in foreign wine grapes then the task would be more difficult. It was, therefore, desirable to determine this point; for it has been supposed by many that malic, and not tartaric acid was characteristic of the native American grapes.

I have, therefore, paid especial attention to the proportions of saccharine matter, and to the nature of the acids in the grapes submitted to me for analysis, and have found that, although many of our grapes are too poor in saccharine matter to produce sufficient alcohol for the preservation of the wine, without the addition of sugar to form more alcohol, or of ready formed spirits, that there are some grapes rich enough in saccharine matter to produce, without these additions, excellent light wines, similar to those of France. I have ascertained that malic acid exists in grape juice, in the proportion of nearly one grain to the ounce of grape juice. This acid was found by Mulder in

Bordeaux wines, but he does not state in what proportions, though he says it exists in small quantity.

Tartaric acid and the bi-tartrates, have been found to characterize all the native American grapes which I have analyzed; this acid existing in rather too large proportions for the saccharine matter in most of our grapes.

Cultivation appears to increase somewhat the proportion of saccharine matter, and to diminish that of the tartaric acid; but we have not carried this experiment of cultivation far enough to determine its full effects on the character of the grapes. When we reflect on the fact that all the wine grapes of Europe are the products of cultivation of some very small and not very palatable wild grapes of Asia, and when we see how various are the kinds of grapes thus produced, we cannot fail to perceive that similar experiments with our native grapes may reward us with new and valuable varieties not yet known.

A northern grape transferred to a more genial climate at the south will, without doubt, yield a sweeter fruit. This may not be effected at once, but will come about gradually. Perhaps we may have to resort to seedling vines, and gradually to acclimate the grapes we would cultivate.

The Catawba, Isabella, and Concord grapes are examples of the great improvement we can bring about by cultivation of grape vines, for all these were native American wild grapes, much inferior to those at present cultivated for wine-making and for table use.

On examination of the tabular statement accompanying this report, the reader will see that there are many grapes which promise to repay for cultivation. The Henshaw grape will make a good light wine, like the French clarets; and the Amber grape, of Dracut, Massachusetts, by cultivation, will doubtless become much sweeter, and will produce a highly-flavored wine, with a rich bouquet.

The Catawba, Isabella, and Scuppernong grapes have already proved to be excellent wine grapes, and are extensively cultivated for that purpose. The Clinton, Bartlett, Petit Noir, and Hartford Prolific, will all make good wines.

Those grapes which contain less than 15 per cent. of saccharine matter, will require sugar or alcoholic spirit to be added to them in order to make a wine that will keep. The celebrated Scuppernong wine will not keep without the addition of spirit or sugar, since the grape juice will not produce more than four and nine-tenths per cent. of alcohol. The rich flavor of this grape renders it particularly valuable, the wine having the flavor and bouquet of the celebrated Tokay wine of Hungary. This grape, however, cannot be cultivated in the open air north of Virginia, and is a native of North Carolina. It is desirable that extensive vineyards should be established in that State expressly for the cultivation of this grape, which will make a wine that will be most eagerly sought for as the best of American native wines.

The Catawba grape has already acquired a just reputation as a wine grape, and is extensively cultivated in Ohio, Kentucky, and the middle States. It ripens very late in the latitude of the New England States, and is apt to suffer from early frosts. We must, therefore, select some more hardy or earlier grape for the northern States. The Concord,

Bartlett, Sage, Amber, sugar grape of Plymouth and Cape Cod, are all good grapes for the northern regions. The Clinton, already cultivated, is one of the best of our hardy grapes, and is rich in saccharine contents, though this season it has not shown its sweetness to so much advantage as usual.

The grapes of Connecticut have, this year, failed to do justice to themselves; but it will be seen, by the analysis of last year's growth, that they are generally much richer in saccharine matter than the samples of the present season have proved.

Some object to the peculiar flavor and bouquet of the new wines made from native wild grapes of the north, and are not aware that the wine, by age and proper sulphuring, loses the "foxy" flavor. Mr. E. Paige has proved this in his extensive operations in making wines from our native northern grapes.

The effect of mixing the juices of several different kinds of grapes together, before fermentation, has not yet been properly tried; and I have no doubt that great improvements in the flavor of the wines may be effected by such a method of operating. Within a few years, the manufacture of wines from our native grapes has made great progress; and the wines made in Ashburnham, by Messrs. Glasier & Flint, and in Boston, by Mr. E. Paige, have acquired a wide-spread reputation, and the demand has for some time been beyond the supply.

Native American wines have not only become common in household use, but have taken their place on the communion-tables of our churches, to the exclusion of foreign wines; and the time will come when America will be able to produce most of the wines her people may need. California is, perhaps, the best wine-growing region, but the middle and southern States, without doubt, can do nearly as well in this business; and the north is not so cold that New England cannot produce good, wholesome, and fine-flavored wines from native grapes. We have yet to learn much in the business of manufacturing wines, and this we can learn readily from the wine-makers of Europe, and from those who have had some experience in Ohio. As much depends on the processes of manufacturing as on the nature of the grapes operated with, as is obvious from the numerous varieties of wines made from the same kinds of grapes in Europe. This art we have still to acquire.

CHEMICAL EXAMINATION OF THE JUICE OF GRAPES FROM VARIOUS LOCALITIES IN THE UNITED STATES.

No. 1. Henshaw grapes, from Martinsburg, Virginia. Sent to me from the United States Patent Office, September 1, 1859.

One pound of the grapes when pressed yielded 8 fluid ounces of rich, dark-purple juice, which weighed 9 ounces avoirdupois. The specific gravity of the strained juice was 1.0700. Saccharine matter, by Evans's tables, 17 per cent.

By the copper grape-sugar test, the fluid yields 15.52 per cent. of grape sugar, which will make 7.76 per cent. of absolute alcohol. On fermenting a portion of the juice and distilling it, I obtained 7.5 per cent. of absolute alcohol from the wine.

The coloring matter and the tartaric acid used were precipitated by means of acetate of lead, which gave a fine blue-colored precipitate.

The wine, after fermentation, changed from a deep purple to a deep, rich red color, and was in appearance and taste much like the red wines of Burgundy, in France, but more acid. To diminish the acid taste, and to increase the proportion of alcohol, I took a portion of the grape juice and added water and sugar, and allowed fermentation to take place. It produced an agreeable light wine.

No. 2. Traminer grapes, No. 18, of Weber's list. Received September 16, 1859.

These grapes were obtained in Dorchester, Massachusetts. They are of a pale mahogany-red color. I do not think they were fully ripe.

One pound of these grapes yields 7 fluid ounces of juice, on pressure, and the specific gravity of the strained grape juice was 1.0485. This will indicate, by the saccharometric tables in Evans's book, nearly 12 per cent. of saccharine matter. By the copper test, the proportion of grape sugar was found to be 11 per cent., which indicates the percentage of alcohol would be 5.5 per cent. in the wine.

In order to ascertain the character of the juices of the hard pulps, and of that portion which is contained next to the skins, when the pulp is snapped out from the grapes, I took 8 ounces of the grapes, and separated the pulp from them, and found the pulps by themselves weighed 4½ ounces, and the skins, with what adhered to them, 3½ ounces. On pressure, the pulps gave 2½ fluid ounces of juice, and the skins 2¼ fluid ounces. The specific gravity of the juice from the pulps was 1.052, and from the skins, 1.046. The juice from the pulps yielded 10 per cent. of grape sugar, and that from the skins, 9.5 per cent.

This was an unexpected result, for the juice next the skins tastes sweetest. Undoubtedly, there is more tartaric acid in the hard pulp, and hence the sour taste of the juice therefrom; for the tartaric acid covers the sweet taste.

No. 3. Catawba grapes, from the District of Columbia. Received from United States Patent Office, September 19, 1859.

These grapes were quite ripe. One pound of the grapes, on pressure, yielded 11 fluid ounces of juice, which had the specific gravity of 1.0715, and, by the tables, this should contain between 17 and 18 per cent. of grape sugar. By the copper test, however, the proportion was found to be 21.3 per cent.

The experiment was repeated, and 21.4 per cent. was obtained as the largest yield of grape sugar.

The grape juice was allowed to ferment, and the wine to become clear and fine. The acids were then separated and examined, and tartaric acid, bi-tartrate of potash, and tartrate of lime were obtained, and less than one grain per ounce of malic acid.

In searching for malic acid, the process recommended by Mulder was employed.

The wine was saturated fully with lime, by simmering it upon an

excess of pulverized chalk until all the tartaric acid was converted into insoluble tartrate of lime, and the malic acid, if present, should be converted into the soluble malate of lime. When cold, the solution so saturated by the chalk was filtered, and the malate of lime, with a large quantity of flocculent mucilage, was thrown down. This precipitate, after being washed with alcohol, was dissolved in water, and acetate of lead was added so long as any precipitate fell. This precipitate was collected on a filter, washed, and then was removed and mingled with water saturated with sulphide of hydrogen, which converted all the lead into a sulphide of lead, and set free the malic acid. This was then filtered, and the solution was evaporated to near dryness, and then pure alcohol was added, which took up all the malic acid and left the mucilage insoluble.

This alcoholic solution being evaporated, yielded a small quantity of malic acid, which, on 100 cubic centimeters, about $3\frac{1}{4}$ ounces of the wine, was only 3 grains of dry malic acid.

The nature of this acid was then proved by experiments on its lime-salt, and by nitrate of silver and sub-nitrate of mercury. It responded to all these tests as malic acid.

I am not aware that the proportion of malic acid existing in European wine grapes has been determined, though Mulder says he found a small portion of it in French Bordeaux wines.

I am satisfied that it is not the characteristic acid of American grapes, which yield an abundance of tartrates, like the European wine grapes, the wine casks being incrusted with the argals, or cream of tartar.

So, likewise, our tests indicate that tartaric acid predominates in the American, as in the European grapes.

No. 4. Grapes "from Fairfax county, Virginia." Received from United States Patent Office, September 20, 1859.

These grapes are a large, red variety. The name of them is not known to me.

One pound of them, on pressure, yielded 10 fluid ounces of juice, which had the specific gravity=1.0410, and, by saccharometric tables, should yield 10 per cent. of grape sugar. By the copper test, the proportion obtained was 10.9 per cent. This will give 5.45 per cent. of absolute alcohol, which is too little alcohol to preserve the wine, and therefore more sugar must be added when the juice is set to ferment, or alcohol may be added to the wine when made.

No. 5. Mahogany-colored grape, vitis labrusca, No. 17 of Weber's list. From G. W. Clarke, of Malden, Massachusetts. Received September 21, 1859.

This is a large, red grape, quite ripe, and sweet to the taste.

One pound of the grapes yielded $10\frac{1}{2}$ fluid ounces of juice, which had specific gravity = 1.050, and when boiled and filtered, specific gravity of 1.045. By the tables this should give 11 to 12 per cent. of saccharine matter.

By the grape-sugar copper test, it yields 10.7 per cent. of grape sugar,

or 5.35 per cent. of absolute alcohol. This is too small a proportion to preserve the wine, without the addition of sugar or spirits.

Some of the juice fermented made a pleasant-flavored wine, but it soon soured.

No. 6. Sweet-water grape. A naturalized foreign species, much used as a table grape.

It was desirable to know if this grape would yield juice of sufficient sweetness to add to our sourer native grape juice. Mr. Weber therefore obtained from Mr. Newell Harding, of Boston, some samples of these grapes—No. 19, Weber's list.

One pound of these grapes yielded 12 fluid ounces of juice, which had specific gravity = 1.0525, and should, by the tables, yield nearly 13 per cent. of saccharine matter. By the grape-sugar test it gave only 9.53 per cent. of grape sugar.

Since, however, there is very little tartaric or any other acid in any quantity present, the juice of these grapes may be advantageously mingled with that of our sourer varieties; but still it will be necessary to add some pure loaf-sugar or clarified syrup, in order to keep the wine sound, and to produce more alcohol by its fermentation, the alcohol which the sweet-water grape produces being only 4.76 per cent.

No. 7. Concord grape. Vitis labrusca, No. 22 Weber's list.

This is a medium-sized, purple grape, native in Concord woods. One pound of the grapes yielded 12 fluid ounces of juice, which had specific gravity = 1.0510, and, by the tables, should contain 13 per cent. of saccharine matter, while by the copper test it yielded 15 per cent., and will give by fermentation 7½ per cent. of alcohol.

No. 8. A large dark-red grape, from Concord, Massachusetts. Vitis labrusca, No 20 of Weber's list.

One pound of these grapes yielded 10½ fluid ounces of juice, which had specific gravity = 1.0570, and, by tables, should contain 14 per cent. of saccharine matter. By the grape-sugar test, the juice yielded 11.7 per cent., which would produce 5.85 per cent. of absolute alcohol.

It will be necessary to add sugar or alcohol to this wine to make it keep sweet.

No. 9. Concord seedling, from Mr. Bull's estate, No. 24 of Weber's list.

This is a purple grape, of medium size, and is an agreeable fruit to the taste. It yields 12 fluid ounces of juice per pound of grapes, and the juice has specific gravity = 1.0550, and should, by the tables, contain 13½ per cent. of grape sugar. By the copper test the yield was 11.8 per cent., and the alcohol which this will produce is 5.9 per cent.

No. 10. Second seedling Concord grape, (Bull's,) color purple, size medium, taste sweet and good.

One pound of the grapes yielded 12 fluid ounces of juice, and the

specific gavity of which was 1.0550; saccharine matter, by tables, $13\frac{1}{2}$; grape sugar, by copper test, 11.8; alcohol the juice will produce by fermentation, 5.9 per cent.

It appears, therefore, that the second seedling is not in advance of the first. This may be accidental in this instance, and should not discourage the experiments of cultivation of seedling vines.

No. 11. The Sage grape of Concord—a native of the woods of that town. Cultivated by R. W. Emerson.

This is the largest sized grape I have seen in New England, three of them weighing an ounce. It is No. 25 of Weber's list. Color, pale-red; bunches not very much crowded, but heavy. A pound of these grapes yielded $11\frac{1}{2}$ ounces of juice, which had specific gravity of 1.0465, and, by the tables, should contain $11\frac{1}{4}$ per cent. of saccharine matter.

By the copper test I obtained from the juice 11 per cent., which is equivalent to 5.5 per cent. of absolute alcohol. Sugar or spirit must be added to this juice when made into wine.

No. 12. Light-red grape, from Bedford, Massachusetts. Vitis æstivalis, No. 21 of Weber's list.

A rather tart grape. Juice pale yellowish. One pound of the grapes yields $11\frac{1}{2}$ fluid ounces of juice, the specific gravity of which is 1.053, and the saccharine contents, by tables, 13 per cent. By the grape-sugar test, however, only 8.97 per cent. was obtained, equivalent to 4.48 per cent. of absolute alcohol. Sugar or spirit is required for this wine, and probably both, with water, will be needed, as the juice is so strongly acid. It contains much tartaric acid, more than many of the other grapes.

No. 13. Amber grape, Dracut; No. 26 of Weber's list.

A light-red grape, with much translucency, very fragrant, bunches well shouldered, full, and heavy. This sample was not quite ripe, and I subsequently procured another which was fully ripe. One pound of grapes from sample 26 yielded 11 fluid ounces of juice, which had specific gravity of 1.0580, and, by tables, should contain 14 per cent. of saccharine matter, but yielded to grape-sugar test only 10.97 per cent., which is equivalent to 5.48 per cent. absolute alcohol.

No. 14. Amber grape. Received from Asa Clement, of Dracut, October 5, 1859.

This lot was fully ripe. These grapes are of medium size and very handsome. The variety was found by Mr. Clement in the woods of Dracut, and has been cultivated by him several years.

A pound of these grapes yielded 11 fluid ounces of juice, having a specific gravity of 1.0550, and containing, by tables, 14 per cent. of saccharine matter, while by copper test the yield was 13.6 per cent. of grape sugar, equivalent to 6.8 per cent. of absolute alcohol. The wine made from the juice of these grapes will have to be reinforced by sugar

or spirit to make it keep sweet; probably water will be required to reduce the acid and sugar to produce more alcohol. The high aroma of the grape makes it desirable as a wine grape, since the wine will have a peculiar bouquet, quite strongly marked.

No. 15. Isabella grapes, from A. Harshbarger, near Veytown, Mifflin county, Pennsylvania. Received from United States Patent Office, October 1, 1859.

These grapes were quite ripe. Color, dark purple; size, medium; bunches well filled. One pound of these grapes yielded, on pressure, 10½ fluid ounces of the juice, and the juice had specific gravity 1.064, from which the tables indicate 16 per cent. of saccharine matter; but the grape-sugar test gives but 14.7 per cent. of grape sugar, equal to 7.03 per cent. of absolute alcohol.

These grapes will make a light wine, but it will keep if well bottled and placed in a cold cellar. A little sugar added during the fermentation will add to its strength. I found about one grain of malic acid to an ounce of the grape juice.

No. 16. Sugar grape, of Plymouth, Massachusetts. A white grape, a little above medium size, and in favorable seasons very sweet and good. Sample furnished by T. O. Jackson, of Plymouth.

One pound of the grapes yields 10 fluid ounces of juice, which has specific gravity of 1.040, and by tables should contain 10 per cent. of saccharine matter. By the grape-sugar test, 10.33 per cent. of grape sugar is indicated, equivalent to 5.16 per cent. of absolute alcohol.

This grape grows abundantly at Manumet, near Plymouth, at Sandwich, and in many places on and near Cape Cod. It is worthy of attention, since the juice of these grapes will make very delicate white wine.

No. 17. Vitis labrusca, Hartford, Connecticut, No. 10 of Weber's list.

A medium-sized grape. One pound of the grapes yielded 10 fluid ounces of juice, which had specific gravity 1.036, and, by tables, should contain 9 per cent. of saccharine matter. The grape-sugar test gives only 5.73 per cent., equivalent to 2.86 per cent. of alcohol.

It is probable that the grapes were not quite ripe, for this variety generally yields more saccharine matter than found at this time. The matters which would have formed grape sugar, if the grape was ripened, served to augment the density of the juice, and hence the disagreement between the tabular estimate and the actual result of analysis.

No. 18. A large white grape, from near Hartford, Connecticut, No. 5 of Weber's list.

One pound of the grapes yielded 10½ fluid ounces of juice, having a specific gravity of 1.030, from which the tables indicate 7½ per cent.

of saccharine matter, and the copper test gives but 4.8 per cent., equivalent to 2.4 per cent. of absolute alcohol.

The remarks on No. 17 also apply to this example. The season appears to have affected the Connecticut grapes more unfavorably than it did those of Massachusetts.

No. 19. Vitis cordifolia, No. 11 of Weber's list. Near Hartford, Connecticut.

This is a medium-sized grape. One pound of the grapes yields 10½ fluid ounces of juice, and its specific gravity is 1.036; from which the tables indicate 9 per cent. of saccharine matter. The copper test gives but 6.2 per cent. of grape sugar. The grapes could not have been ripe.

No. 20. Vitis cordifolia, No. 8 of Weber's list, Connecticut.

Size of the grapes, medium; quantity of juice per pound, 10½ fluid ounces; specific gravity of the juice, 1.036; saccharine matter, by tables, 9 per cent., and copper test, 6.2 per cent. These grapes could not have been ripe.

No. 21. Vitis cordifolia, No. 7 Weber's list.

These grapes were of medium size. A pound of them yielded 10½ fluid ounces of juice, which had specific gravity 1.044, and the saccharine contents, by tables, would be 11 per cent.; while the grape-sugar test gave 8.7 per cent., equivalent to 4.35 of absolute alcohol.

No. 22. Vitis cordifolia, No. 27 Weber's list.

Small black grapes, in closely-packed bunches. One pound of them yielded 10½ fluid ounces of juice, of specific gravity 1.035; from which, by tables, the saccharine matter would be 9 per cent., but the copper test gives but 4.7 per cent.

No. 23. Scuppernong grapes, from near Wilmington, North Carolina.

These grapes are more remarkable for the high flavor of the wines they make than for the saccharine matter they contain. It has always been necessary to add a portion of brandy or some other spirit to keep the wine from souring; nevertheless, the Scuppernong wine is the best thus far produced in the United States.

The grapes have a very thick, leathery skin, which is of a green color, with a few rusty specks on the surface of them.

The pulp is soft and juicy, and the skins give a peculiar aroma to the wine, which is similar to the Tokay of Hungary. Sometimes I have observed a peculiar bitter taste in the wine, due to the crushed seeds of the grape, and not unfrequently the flavor and odor of whisky indicate the introduction of that liquor into the wine. With proper attention and care, Scuppernong wine may be made so fine as to excel all other wines made on this continent; and I would earnestly advise those interested to attend to the cultivation of this grape, in regions

where the vine will grow, and make use of more skill in the manufacture of the wine.

The grape will grow and ripen its fruit anywhere south of Washington, but has thus far proved more prolific in the soil of North Carolina, especially near Halifax.

The sample of grapes I operated upon was sent to me from the United States Patent Office on the 3d October, 1859.

One pound of the grapes when pressed yielded 8 fluid ounces of juice, which had a specific gravity 1.048, and, by tables, should contain 12 per cent. of saccharine matter, but, by the grape-sugar test, yielded 9.8 per cent., equivalent to 4.9 per cent. of absolute alcohol.

If 4 or 5 per cent. of sugar is added during the fermentation of the juice, the proportion of alcohol will be raised to that of sherry wine, if the fermentation is allowed to become complete. Only the purest white sugar, sugar candy, or refined syrup should be employed.

Another method will give a still richer wine. Distil a portion of the wine, and add the spirit obtained to the wine when it is made and fined. This will keep up the flavor of the Scuppernong grapes, and not vitiate the wine by any foreign flavors, such as are given by brandy and whisky so often put into this wine.

The Scuppernong grape-vines are, as I learn, cultivated on trellises or arbors raised to some height above the ground, as is practised in Ischia and Venitian Lombardy.

Thus far the vineyards are wholly domestic institutions in North Carolina; but I think the cultivation of this grape will amply repay any one who will devote his entire energies to planting vineyards of this vine, and in manufacturing the wine on a large scale.

No. 24. Hartford Prolific, No. 31 of Weber's list. Connecticut.

Small black grapes. A pound of them yields 10½ fluid ounces of juice, which has specific gravity of 1.056, and, by the tables, should contain 14 per cent. of saccharine matter.

By the grape-sugar test, the yield is 13.8 per cent. grape sugar, or 6.9 per cent. of absolute alcohol.

On searching for the acids, I found tartaric was the chief acid, and it is in part combined with potash as a bi-tartrate, and with lime as a tartrate. Malic acid, in minute proportion, is also present, but there is not more than 1 grain in 1 fluid ounce of the juice of the grapes.

This is a well-known and good wine grape, and was evidently ripe at the time I received the sample.

No. 25. Vitis labrusca, No. 6 of Weber's list. From near Hartford, Connecticut.

This grape yields in one pound 11 fluid ounces of juice, having the specific gravity 1.038, and, by the tables, should contain 10 per cent. of saccharine matter.

By the grape-sugar test, the proportion was 8.2 per cent., and the alcohol it will produce is 4.05 per cent.

No. 26. A small black, hard, and sour grape, No. 28 of Weber's list. Connecticut.

This grape yields in one pound $6\frac{1}{2}$ fluid ounces of juice, which has specific gravity 1.032, which indicates, by tables, 8 per cent. of saccharine matter, while by the copper test we obtained but 5.5 per cent. of grape sugar, equal to 2.7 per cent. alcohol.

No. 27. A large red grape, No. 29 Weber's list.

A pound of these grapes yield $10\frac{1}{2}$ fluid ounces of juice, which has specific gravity of 1.035, and, by tables, contains 9 per cent. of saccharine matter, while by grape-sugar test the proportion is only 6.16 per cent., which will give 3.8 per cent. of absolute alcohol in the wine.

No. 28. Large white grapes, No. 30 Weber's list.

A pound of these grapes yields $10\frac{1}{2}$ fluid ounces of juice, which has a density of 1.036, and, by tables, should contain 9 per cent. of saccharine matter, while by the grape-sugar test it is 5.38 and the alcohol 2.69 per cent. in the wine.

No. 29. Black grapes, medium size, vitis cordifolia. No. 32 of Weber's list.

A pound of these grapes yields 7 fluid ounces of juice, which has a specific gravity of 1.047, and, by the tables, $11\frac{1}{2}$ per cent. of saccharine matter.

By the grape-sugar test, it contains 7.84 per cent., or 3.92 per cent. of alcohol.

No. 30. Large red grapes, vitis labrusca. No. 33 of Weber's list.

One pound of the grapes yields 10 fluid ounces of juice, which has the density of 1.051, and by the tables contains 13 per cent. of saccharine matter, and by grape-sugar test, 13.3 per cent., while the alcohol will be 6.6 per cent.

This is a good wine grape, and was thoroughly ripe.

No. 32. Vitis sinuata, No. 35 of Weber's list.

These are very small black grapes, not much larger than ordinary cherries. The bunches are closely packed, well shouldered, and heavy.

A pound of these grapes yields 8 fluid ounces of juice, which has a density of 1.061, from which we estimate, by the tables, 15 per cent. of saccharine matter, while by the grape-sugar test the proportion found was 11.5 per cent., which represents in the wine 5.7 per cent. of absolute alcohol.

This grape will make a good wine.

No. 33. Dark-red grapes, vitis labrusca. No 36 of Weber's list.

A pound of these grapes yields 10 fluid ounces of juice, and the density of the juice is 1.042, whence the tables indicate $10\frac{1}{2}$ per cent. of

saccharine matter, while the copper test gives 14.3 per cent., from which the alcohol computed will be 7.15 per cent. This is a good wine grape.

No. 34. Catawba grapes, grown at East Cambridge, Massachusetts.

These grapes, which ripened November 21, were among the last of the season, and it was a matter of some interest to know what they would produce.

A pound of them yielded 11½ fluid ounces of juice, which had a density of 1.063, and, by the tables, should yield 15 per cent. of saccharine matter. By the grape-sugar test, the yield was 16.9 per cent, of grape sugar, equivalent to 8.45 absolute alcohol.

It appears, then, that this grape will make a good wine as far north as Massachusetts. It is, however, very late in ripening here.

No. 35. Adelia, or Petit Noir.

A small black grape, raised in Orange county, New Jersey. It is a native American, though named in its synonym in French.

The sample was sent to me from the United States Patent Office, October 13, 1859.

This grape yields in one pound 10¼ fluid ounces of juice, which has the density of 1.061, and by the table its saccharine matter would amount to 14½ per cent., while by the grape-sugar test it is 15.33 per cent., representing 7.66 per cent. of alcohol in the wine. It is a good grape, as proved by trial.

No. 36. Bartlett grape.

This grape was discovered in Lexington woods, by the late Elias Phinney, and is a large white grape, with one side light-red, which is that exposed to sunshine.

The sample was furnished to me by F. Alger, of South Boston.

A pound of these grapes yielded 11½ fluid ounces of juice, and its specific gravity was 1.0680. By the tables, the saccharine matter would be 17 per cent., while by the copper test the sugar was 12.87 per cent., representing 6.44 per cent. of alcohol.

No. 37. Clinton grapes, East Cambridge, furnished by Mr. Brackett October 29, 1859.

These grapes are of a very dark-purple, and are of medium size. A pound of them produced 11 fluid ounces of juice, which had the density of 1.088, which, by tables, indicates 22 per cent. of saccharine matter, while the grape-sugar test gives 20.5 per cent., equivalent to 10.25 per cent. of absolute alcohol.

This is an excellent wine grape and needs no more sugar to make a good light-red wine.

No. 38. Last year I had occasion to make an analysis of some of the wild grapes of Connecticut, used in Boston for making wine, and since

the season was more favorable than the past I add this analysis to do the Connecticut grapes more justice than they have done themselves generally this year.

Vitis labrusca. Medium-size purple grapes. Sample furnished by E. Paige, of Boston, in 1858.

A pound of the grapes yielded 10 fluid ounces of juice, which had the density of 1.052 and, by tables, should contain 13 per cent. saccharine matter. By the grape-sugar test the proportion was found to be 17.8 per cent., and the alcohol 8.9 per cent.

This I believe will be the average in good seasons. The past summer and the autumn especially has been unusually cold in the New England States.

I have given a tabular *resumé* of the principal facts discovered by the foregoing analysis, which will present to the eye a ready means of comparison of the products of the different grapes, so far as their wine-making properties are concerned.

CHARLES T. JACKSON, M. D.

Boston, *December* 24, 1859.

Tabular statement of results of analysis of grapes of the United States, by Charles T. Jackson, M. D.

No.	Name and locality of grapes, and from whom received.	Color, &c	Juice, per pound.	Specific gravity.	Saccharine, per cent., according to Evans's tables.	Grape sugar, indicated by copper test.	Absolute alcohol, computed from grape sugar.
			fluid ozs.				
1	Henshaw grape, Martinsburg, Va.; Patent Office	Dark-purple, medium size	8	1.0700	17	15.52	7.76
2	Traminer grapes, Dorchester, Mass.; No. 18 of Weber	Pale mahogany-red, medium size	7	1.0485	12	11	5.5
3	Catawba, D. C.; Patent Office	Pale-red, medium size	11	1.0751	17.5	21.3	10.65
4	Fairfax county, Va.	Large red	10	1.0410	10	10.9	5.45
5	Mahogany-colored grapes, Malden, Mass.; No. 17 of Weber.	Large red	10½	1.0500	12	10.7	5.35
6	Sweet-Water, Boston, Mass ; No. 19 of Weber	White, medium size	12	1.0525	13	9.53	4.76
7	Vitis labrusca, No. 22 of Weber; Concord, Mass	Purple, medium size	12	1.0510	13	15	7.5
8	Vitis labrusca, 20 of Weber ; Concord, Mass.	Dark-red, large size	10½	1.0570	14	11.7	5.85
9	Concord seedling No. 1; No. 24 of Weber	Purple, medium size	12	1.0550	13½	11.8	5.9
10	Concord seedling No. 2; No. 23 of Weber	Purple, medium size	12	1.0550	13½	11.8	5.9
11	Sage grape, R. W. Emerson's, Concord, Mass. ; No. 25 of Weber.	Pale-red, very large	11½	1.0465	11¼	11	5.5
12	Vitis æstivalis, No. 21 of Weber; Bedford, Mass	Light-red, medium size	11½	1.0530	13	8.97	4.48
13	Amber grape, No. 26 of Weber; Dracut, Mass	Light-red, translucent, fragrant	11	1.0580	14	10.97	5.48
14	Amber grape, A. Clement, Dracut, Mass.; (dead ripe)	Light-red, translucent, medium size	11	1.0550	14	13.6	6.8
15	Isabella grape, Mifflin county, Penn. ; Patent Office	Purple, medium size	10½	1.0640	16	14.7	7.03
16	Sugar grape, Plymouth, Mass.; T. O. Jackson	White grape, round, rather large size.	10	1.0400	10	10.33	5.16
17	Vitis labrusca, No. 10 of Weber; Hartford, Conn	Medium size	10	1.0360	9	5.73	2.86
18	Large white grape, Conn.; No. 5 of Weber	Large white	10½	1.0300	7½	4.80	2.4
19	Vitis cordifolia, No. 11 of Weber; Conn.	Medium size	10½	1.0360	9	6.2	3.1
20	Vitis cordifolia, No. 8 of Weber; Conn	Medium size	10½	1.0360	9	6.2	3.1
21	Vitis cordifolia, No. 7 of Weber; Conn	Medium size	10½	1.0440	11	8.7	4.35
22	Vitis cordifolia, No. 27 of Weber; Conn.	Black, small size	10½	1.0350	9	4.7	2.35
23	Scuppernong grapes, Wilmington, N. C.; Patent Office	White grapes, thick tough skins, medium size.	8	1.0480	12	9.8	4.9
24	Hartford Prolific, No. 31 of Weber; Conn	Small black grapes	10½	1.0560	14	13.8	6.9

TABULAR STATEMENT—Continued.

No.	Name and locality of grapes, and from whom received.	Color, &c.	Juice, per pound.	Specific gravity.	Saccharine, per cent., according to Evans's tables.	Grape sugar, indicated by copper test.	Absolute alcohol, computed from grape sugar.
			fluid ozs.				
25	Vitis labrusca, No. 6 of Weber; Hartford, Conn	Purple, medium size	11	1.0380	10	8.1	4.05
26	No. 28 of Weber. (See his report.)	Small black, hard, sour	6½	1.0320	8	5.5	2.7
27	No. 29 of Weber. (See his report.)	Large red	10½	1.0350	9	6.16	3.8
28	No. 30 of Weber. (See his report.)	Large white grapes	10½	1.0360	9	5.38	2.69
29	Vitis cordifolia; No. 32 of Weber	Black, medium size	7	1.0470	11½	7.84	3.92
30	Vitis labrusca; No. 33 of Weber	Large red grapes	10	1.0510	13	13.3	6.6
31	Vitis cordifolia; No. 34 of Weber	Black, medium size	10	1.0540	13½	10.03	5
32	Vitis sinuata; No. 35 of Weber	Very small black grapes, in close clusters.	8	1.0610	15	11.5	5.7
33	Vitis labrusca; No. 36 of Weber	Dark-red	10	1.0420	10½	14.3	7.15
34	Catawba grape, from near Boston, Mass.	Pale-red, medium size	11½	1.0630	15	16.9	8.45
35	Adelia or Petit Noir, Orange county, N. J.; Patent Office	Small, black	10¼	1.0610	14½	15.33	7.66
36	Bartlett Grape, origin Lexington, Mass.; F. Alger, South Boston	Large, pale-red and green	11½	1.0680	17	12.87	6.44
37	Clinton, East Cambridge; Mr. Brackett	Dark-purple, medium size	11	1.0880	22	20.5	10.25
38	Vitis labrusca, of Conn.; in more favorable year, 1858, sample from E. Paige.	Purple, medium size	10	1.0520	13	17.8	8.9

BOSTON, *December* 24, 1859

CHARLES T. JACKSON, M D.

REPORT ON AMERICAN GRAPES.

DETERMINATION OF THE PROPORTIONS OF ACIDS IN NATIVE AMERICAN GRAPE WINES MADE FROM THE PURE JUICE OF THE GRAPES.

BY CHARLES T. JACKSON, M. D.

In this examination I employed graduated solution of pure caustic soda, in distilled water, and prepared it so that every degree of the acidimeter corresponded to one tenth of a grain of pure tartaric acid. This test gives results sufficiently exact, though a little of the acid in the wines is malic acid, as I had previously ascertained.

In applying this test, any acetic acid which had formed in the wine during the process of fermentation was first removed by evaporating the wine until it was all volatilized, the acetic acid passing off in vapor, while all the tartaric and malic acid remained. One thousand grains of each of the wines was operated upon in determining their acidity. In the tabular *resumé* the results will be stated in per centages, as the other ingredients have been.

It may be observed that pure grape juice, merely fermented and not diluted with any water, has been the subject of these experiments. In making wines from American grapes, it is customary to add a certain proportion of water and of sugar to the grape juice, to overcome the acids, and to make the wines more agreeable. As the sugar is converted into alcohol, it gradually precipitates a portion of the tartaric acid as bi-tartrate of potassa, or cream of tartar, thus relieving the wine of part of its acidity.

No. 1. The juice of the Henshaw grapes, from Martinsburg, Virginia, yielded, in 1,000 grains, 11.4 of tartaric acid, or 1.14 per cent.

No. 3. The Catawba grape juice, Washington, D. C., yielded, in 1,000 grains, 10 grains of tartaric acid, or 1 per cent.

No. 6. Sweet-water grape, Harding's, tartaric acid in 1,000 grains, 6 grains, or 0.6 per cent.

No. 7. Vitis labrusca, No. 20 of Weber's list, from Concord, Massachusetts, yielded, in 1,000 grains of the fermented juice, 14.2 grains, or 1.42 per cent.

No. 9. Concord seedling, Bull's, Concord Massachusetts, No. 24 of Weber's list, yielded, in 1,000 grains of the fermented juice, 6 grains of tartaric acid, or 0.6 per cent.

No. 11. Sage grape, of Concord, Massachusetts, No. 25 of Weber, yielded, in 1,000 grains of the fermented juice, 11 grains of tartaric acid, or 1.1 per cent.

No. 12. Vitis æstivalis, from Bedford, Massachusetts, No. 21 Weber, yielded 14.6 grains of tartaric acid per 1,000 grains of the wine, or 1.46 per cent.

No. 13. Amber grape, of Dracut, Asa Clements, yielded, in 1,000 grains of the wine, 15 grains of tartaric acid, or 1.5 per cent.

No. 16. Sugar grape, of Plymouth, Massachusetts, yielded, in 1,000 grains of the wine, 14.8 grains of tartaric acid, or 1.48 per cent.

No. 17. Vitis labrusca, Connecticut, No. 10 Weber, yielded, in 1,000 grains of the wine, 7.2 grains of tartaric acid, or 0.72 per cent.

No. 18. White grape, from Connecticut, No. 5 of Weber, yielded, in 1,000 grains, 12 grains of tartaric acid, or 1.2 per cent.

No. 19. Vitis cordifolia, Connecticut, No. 11 Weber, yielded, in 1,000 grains of the wine, 14 grains of tartaric acid, or 1.4 per cent.

No. 20. Vitis cordifolia, No. 8 of Weber's list, yielded, in 1,000 grains of the wine, 13 grains of tartaric acid, or 1.3 per cent.

No. 21. Vitis cordifolia, Connecticut, No. 7 of Weber's list, yielded, in 1,000 grains of the wine, 15 grains of tartaric acid, or 1.5 per cent.

No. 22. Vitis cordifolia, No. 27 of Weber, Connecticut, yielded, per 1,000 grains of the wine, 18 grains of tartaric acid, or 1.8 per cent.

No. 23. Scuppernong grapes, from near Wilmington, North Carolina, yielded, in 1,000 grains of the wine, 17 grains of tartaric acid, or 1.7 per cent.

No. 25. Vitis labrusca, Hartford, Connecticut, No. 6 of Weber, yielded, in 1,000 grains of the wine, 13.8 grains of tartaric acid, or 1.38 per cent.

No. 26. Small black grape, No. 29 of Weber's list, yielded, per 1,000 grains of the wine, 12.4 grains of tartaric acid, or 1.24 per cent.

No. 27. Large red grape, No. 29 of Weber's list, yielded in 1,000 grains of the wine, 9.2 grains of tartaric acid, or 0.92 per cent.

No. 28. Large white grape, No. 30 of Weber's list, yielded per 1,000 grains of the wine, 14 grains of tartaric acid, or 1.4 per cent.

No. 29. Vitis cordifolia, No. 32 of Weber's list, yielded per 1,000 grains of the wine, 12 grains of tartaric acid, or 1.2 per cent.

No. 30. Vitis labrusca, No. 33 of Weber, yielded per 1,000 grains of the wine, 11.8 grains of tartaric acid, or 1.18 per cent.

No. 31. Vitis cordifolia, No 34 of Weber's list, yielded per 1,000 grains of the wine, 14.4 grains of tartaric acid, or 1.44 per cent.

No. 32. Vitis sinuata, No. 35 of Weber, yielded per 1,000 grains of the wine, 20 grains of tartaric acid, or 2 per cent.

No. 33. Vitis labrusca, No. 36 of Weber, yielded per 1,000 grains of the wine, 15 grains of tartaric acid, or 1.5 per cent.

No. 34. Catawba grape, from near Boston, Massachusetts. This wine gave per 1,000 grains of the juice, 14 grains of tartaric acid, or 1.4 per cent.

No. 35. Adelia, or Petit Noir, Orange county, New Jersey, yielded per 1,000 grains of the wine, 8 grains of tartaric acid, or 0.8 per cent.

No. 36. Bartlett grape, South Boston, Massachusetts. The wine of these grapes yielded, per 1,000 grains, 19 grains of tartaric acid, or 1.9 per cent.

No. 37. Clinton grape, East Cambridge, Massachusetts. The wine of this grape yielded, per 1,000 grains, 19 grains of tartaric acid, or 1.9 per cent.

The other wines were used up in other researches, before I was aware that it was desired that I should determine the acidity of the specimens.

It is probable, however, that there are here given a sufficient number

of examples of our native grapes, including all the species, to settle the question as to the proportion of acids in them.

It will be remarked that, while the proportion of sugar is not increased in grapes by cultivation, the tartaric acid is diminished in a remarkable manner.

Tabular statement of proportion of tartaric acid per cent.

	Per cent. tartaric acid.		Per cent. tartaric acid.
Number 1	1.14	Number 23	1.7
3	1	25	1.38
6	0.6	26	1.24
7	1.42	27	0.92
9	0.6	28	1.40
11	1.1	29	1.20
12	1.46	30	1.18
13	1.5	31	1.44
16	1.48	32	2
17	0.72	33	1.5
18	1.2	34	1.4
19	1.4	35	0.8
20	1.3	36	1.9
21	1.5	37	1.9
22	1.8		

ON THE PRESENCE OF TARTARIC ACID IN THE CULTIVATED GRAPE OF THE UNITED STATES.

BY THOMAS ANTISELL, M. D., PROFESSOR OF CHEMISTRY IN THE MEDICAL DEPARTMENT OF GEORGETOWN COLLEGE, D. C.

The assertion has been frequently made in publications in this country, that the growth of grape-vines for the manufacture of wine is a project of doubtful success, since in the United States the grape does not form tartaric acid in the same large proportion in which it is found to exist in the European plant, its place being supplied by the vegetable acids, which alter the flavor and value of the wine produced.

Inasmuch as the cultivation of the grape is now prosecuted with success in the Ohio valley, and extending over a large section of country, and since the climate and soil of the United States are eminently favorable to the growth and propagation of the vine, as shown by the abundant woody development, it becomes a matter of importance to know whether the juice of the fruit grown in the United States differs in any important particular as regards the nature or amount of acid from that of European grapes.

For the successful manufacture of wine the presence of tartaric acid is all essential; for, by its tendency to unite with the potass, also present in the pulp, and to form the acid tartrate of potass (cream of tartar)—a salt soluble in the pulp of the grape, but not soluble when,

by fermentation, alcohol is formed in the juice, and which is therefore thrown down and separated from the wine forming the "tartar"—depends the superiority and greater healthfulness of true wine over the fermented liquors of other pulpy fruits, whether indigenous or exotic.

In the pulpy fruits used in the manufacture of domestic wines the acids present are chiefly malic and citric, which form with potash salts soluble not only in the fresh juice but also in the fermented wine. They are consequently not thrown down or separated out of the wine as alcoholization goes on in the fermenting vats, and their presence in the wine renders the latter unhealthy, it being liable to become acid in the stomach, and to produce derangement of function in that organ. Hence, the real superiority of the wine of the grape above the fermented juices of other fruits depends not upon fancy, nor an uneducated taste, but upon the production of an alcoholic liquid not containing within it substances injurious to digestion.

Tartaric acid is as essential as sugar in the manufacture of wine; in dry wines the tartar predominates much more than in sweet, in which sugar is the dominant element. This acid diminishes as the fruit approaches ripeness; and it is also diminished in grapes grown where the climate is hot and dry in the season when the fruit is ripening. In the south of Europe, when, in the autumn, the African winds blow northward, when the grape is ripening, those portions of the Mediterranean shores exposed to a hot and dry wind do not produce dry wines, but wines that are always sweet, because the proportion of sugar and tartar are out of relation with each other. Thus the rich, sweet grape of Malaga has but little tartaric acid, and a sweet wine is the result, while the wine of Burgundy has more tartar and less sugar, and produces a more acid wine.

To determine the presence and proportion of tartaric acid, I selected the Catawba grape as that most abundantly grown for wine purposes, and, by the kindness of Mr. Michael Werk, of Greene county, Ohio, who placed at my service several pounds of ripe grapes, and a sample of the tartar produced, I have been enabled to furnish the following results:

Six pounds of grapes, pressed, yielded 56 ounces of a literally clear, colorless juice of specific gravity 1.074. This juice was diluted with an equal amount of distilled water, and the mixed liquid passed through a fine strainer to separate the cellulose and albuminous matters not dissolved; solution of chloride of calcium with ammonia was added so long as a precipitate was produced, allowing the liquor to rest between the additions; the precipitate was then dissolved in hydrochloric acid, and ammonia added. The precipitate was then collected and dried at a gentle heat, and weighed against a tared filter. By this process the malic acid present is avoided, and the precipitate obtained is either wholly tartrate of lime, or, if not containing any racemic acid present in the juice, forming a racemate of lime. As racemic acid is only a modified form of tartaric acid, and as it is not known to act in any way differently in wines from its congener, it was not deemed necessary to separate them in this examination.

The amount of tartrate of lime attained from six pounds of grapes, or from $4\frac{2}{3}$ pints of juice, was $4\frac{32}{100}$ grammes, (nearly 67 grains,) which

represents $50\frac{16}{100}$ grains of acid, tartrate of potash, originally existing in the juice.

This would give the quantity of cream of tartar present in each ounce of juice as nearly one grain, admitting the whole of the tartaric acid to be combined with potassa, but as there is always some tartrate of lime present in the juice, the amount of cream of tartar is slightly lessened.

The quantity of sugar determined by Fehling's modification of the copper grape-sugar test was 19.6 per cent.

As the grapes examined had ripened very much in the interval between the gathering and the examination, the above proportion of tartrate of potass is probably somewhat less than existed in the fruit. The presence of that amount shows satisfactorily, however, that tartaric acid is the dominating acid in the Catawba grape, and that is produced abundantly in the latitude of Cincinnati.

The sample of crude tartar forwarded by Mr. Werk yielded, on qualitative analysis, acid tartrate of potass, tartrate of lime, sulphate of potass, sulphate of lime, phosphate ammonia, and magnesia. The two last-mentioned salts were present in but small amount.

Mr. Payen, having stated in his work on distillation that the cellular tissue of the pulp contained "tannin," led to a repeated examination of the juice of the pulp; and in every case where common care was taken that the skins should not be pressed, so that any of its liquids might become mingled with those of the pulp, not a trace of tannic acid could be detected, thus verifying Mulder's statement that this acid is wholly confined to the skins.

THE NATIVE GRAPES OF PENNSYLVANIA, NEW JERSEY, NEW YORK, AND NEW ENGLAND.

THEIR WINE-PRODUCING QUALITIES.

BY JOHN F. WEBER, OF WASHINGTON, D. C.

My examination of native grapes began at Orange and the surrounding country, in New Jersey. Some varieties, which I had noticed several years before, first attracted my attention. I found them still vigorous in their natural growth, and capable of improvement. Following a northern direction, I traversed the greater part of the State of Connecticut, meeting, in the township of Canton, with valuable kinds, free from insects. In western Massachusetts, especially in East Hampton, Northampton, Florence, and Leeds, I observed a few varieties well worthy of attention, exhibiting, with regard to the formation of wood and fruit, all the qualities sought in good wine. Such was also the case south and north of Boston. I selected samples of the matured fruit of all those probably most capable of improvement, and transmitted them to Dr. Jackson, of Boston, for chemical analysis.

The value of grapes, either for wine-making or table use, being de-

termined by the amount of saccharine matter contained, it is important to know to what species a promising new variety may belong.

From the great difference existing between a table grape and a wine grape, it becomes necessary that, wherever the manufacture of wine is the object, the former should be altogether ignored, its sweet, yet watery, juice producing but a weak wine.

Though the wine grape has also, and should have, a sweet taste, it is a different one from that of the table grape, as it is vinous instead of watery, and piquant instead of flat, attributable to the amount of sugar and acids being well proportioned.

Actuated by this fundamental view, I designated the following varieties for chemical analysis, desiring to improve them thoroughly and systematically:

No. 1. *Vitis vinifera.*—A grape extensively grown in the vicinity of Paris, for the market and wine-making; introduced eight years ago, and cultivated with entire success, by John Charles Savalle, near Orange, New Jersey. It seems to be perfectly acclimatized. Its character and habitus consist in the following points: a healthy, vigorous growth; short-jointed light-brown wood; medium sized, roundish leaves, of dark-green color and a bluish tinge, a fine down on the upper part, soft and fine nerves; bunches and berries medium sized, well set, compact, and well shouldered; of a fine dark-blue color; ripens toward the end of September, and, according to the statement of Mr. Savalle, a fortnight earlier than in Paris. It is a regular bearer, and in every respect a first class grape-vine. The soil where it grows is not favorable to its full development, being sandy and wet, yet porous enough to prevent water from stagnating. A location on the south side of a house would be more suitable. Mr. Savalle takes down this vine every winter, wraps it in straw, lays it flat on the ground, and covers it with a board, on which are placed stones of sufficient weight to keep it in that position.

This is the whole secret of success with foreign grapes. Tender and highly improved as they are, they cannot bear our severe winter. In central Germany, northern France, and the greater part of Hungary, the custom is to lay down the grape-vines before the winter sets in, and protect them from the attacks of high winds and piercing cold, otherwise they would there be winter-killed as well as here.

No. 2. *Vitis labrusca.*—A blue wild native grape-vine, found in the woods near Haydenville, Hampshire county, Massachusetts, and transplanted on the south side of his dwelling-house, by James R. Salomon, of Leeds, near Florence, Massachusetts. Its habitus resembles much that of the Isabella. The wood is, however, of a darker shade, short-jointed, and of healthy growth; leaves rather large, heart-shaped, and of a light-green color, downy on the lower part; bunches contain from ten to twenty-five berries, large and oval shaped; thin skin and juicy, sweet pulp; ripens about the 15th of September; a good regular bearer. The soil in which it grows is a sandy loam, rather wet, the situation open to the east and south, but well protected from north and west winds by a chain of mountains. This vine would improve by propagation, and may be rendered a desirable table and market grape, profitable to its cultivator.

No. 3. *Vitis labrusca.*—A blue wild native grape-vine, probably a seedling of an old vine standing near by; very prolific and luxuriant growth; stands at the foot of a hill, well protected from the north and west, but open to the east and south; in a wet, sandy soil, on the farm of Solomon Phelps, near Florence, Massachusetts. I have known this grape seven years, and always considered it possessed of good points and qualities worthy of propagation. The wood is dark-brown, long-jointed; leaves of medium size, heart-shaped, dark-yellow down on the lower side, and of a pale yellowish-green on the upper, nerves fine; bunches contain from fifteen to twenty-five large round berries; of an agreeable wine taste; ripens by the end of September. It deserves improving, and will be a desirable acquisition for the vineyard. The late frosts in June destroyed most of the fruit in this section, which, in favorable seasons, abounds in luscious grapes of all colors and sizes.

No. 4. *Vitis cordifolia.*—A blue wild native grape, standing on a sandy plain, northwest of Mount Tom, on the farm of William Knüpfer, of East Hampton, Massachusetts. Wood light-brown, short-jointed, not so vigorous, but healthy growth; leaf medium size, heart-shaped, with fine nerves, yellowish-green on the upper side and bright-yellow on the lower; clusters compact, with twenty to twenty-five round, medium-sized berries, of a juicy, agreeable wine taste; ripens toward the end of September. A good grape for red wine, or claret.

No. 5. *Vitis labrusca.* Crystal grape.—A white wild native grape, was found in a swamp on the farm of Salomon D. Case, Canton Center, Hartford county, Connecticut, and transplanted by Mr. Case on an open field, or rather side-hill, facing southeast, well sheltered from the north and northwest wind. He has propagated considerably from this vine, by making layers, of which many are already bearing. The wine has a pleasant taste, much like the genuine Madeira, and needs no sugar. The soil is gravelly loam, rather strong, but contains valuable mineral substances, and is well adapted for the grape. The vine is of a healthy, vigorous habit, ripens wood and fruit well, and is a regular bearer. Wood brown, short-jointed; leaf medium, heart-shaped, strong nerves, of a yellowish-green on the upper side and light-yellow on the lower; clusters medium size; berries large, round, flat on both ends, of a green color, with snowy-white specks; ripens about the fifteenth of September; sweet and juicy. See analysis and report of Dr. Jackson, page 49.

No. 6. *Vitis labrusca.*—A blue wild native grape. Wood reddish-brown, short-jointed, of a healthy growth; leaf small, heart-shaped, strong nerves, yellowish-green on the upper and dark-yellow on the lower side; clusters, or bunches, large; berries large, round, and flat, very sweet; ripens middle of September. Soil the same as above; location open and level. See analysis, page 51.

No. 7. *Vitis cordifolia.*—A black wild native grape; very old vine, standing on the same farm, in a wet, stony soil, surrounded by wood. Wood dark-brown, short-jointed, and of healthy growth; leaf medium size, heart-shaped, tender nerves, light-yellow on both sides; bunches large, of a fine form; berries large, round, of an agreeable wine taste,

best quality; will make a good claret; ripens in the beginning of September. See analysis, page 50.

No. 8. *Vitis cordifolia.*—A blue wild native grape, on the same farm; grows on a dry, stony soil, in an open, level situation. Wood dark-brown, short-jointed, and of vigorous growth; leaf medium size, heart-shaped, fine nerves, yellowish-green on the upper and light-yellow on the lower side; bunches large; berries round, and flat on both ends, rather large, of a pleasant wine taste; juice dark-colored; makes a good claret wine; ripens middle of September. See analysis, page 50.

No. 9. *Vitis labrusca.*—A red wild native grape; grows in a swamp on clay subsoil, among brushes, likewise on Mr. Case's farm. Wood light-brown, short-jointed, and healthy growth; leaf small, round, and strong nerves, yellowish green on the upper, and bright yellow on the lower side; bunches compact; berries round, medium size; very sweet; ripens middle of September; a good table grape.

No. 10. *Vitis labrusca.*—A purple grape, with copper-colored specks; wild native; grows in the same situation and soil as the preceding. Wood light-brown, short-jointed, and robust growth; leaf medium size, round, strong nerves, yellowish green on the upper, and yellow on the lower side; bunches medium; berries round; sweet, juicy, and spicy taste; will make a good schiller wine; ripens middle of September. See analysis, page 49.

No. 11. *Vitis cordifolia.*—A red wild native grape, standing on the same soil and location as the preceding. Wood light-brown, short-jointed, and strong growth; leaf medium size, round, with fine, tender nerves, light-yellow on the upper, and yellow on the lower side; bunches medium size; berries large, oval, sweet, and spicy; a good table and wine grape; ripens middle of September. See analysis, page 50.

No. 12. *Vitis labrusca.* Sugar grape.—A white wild native grape, stands on an elevation, a quarter of a mile from the sea-coast, Rocky Hill, and four miles north of Plymouth, Massachusetts, on an old pasture, overrun with briars, belonging to Mrs. Mental Peirce. Soil dry, sandy gravel. Wood brown, short-jointed, of healthy but moderate growth; leaf medium, heart-shaped, strong nerves, yellowish-green on the upper, and dark yellow on the lower side; bunches and berries of medium size, round and flat; very sweet; ripens by the end of September; good table grape.

No. 13. *Vitis cordifolia.*—A mahogany-colored wild native grape, stands on a dry, strong soil, on an old wood lot, in a free, high situation, belonging to James Merrick, South Scituate, Massachusetts. Wood red-brown, short-jointed, and vigorous growth; leaf medium, round, ribs and nerves fine, and of a bright reddish color; bunches medium; berries, ditto, round, and of agreeable wine taste; ripens middle of September.

No. 14. *Vitis cordifolia.*—A white, grey-spotted, wild native grape, resembles much the German Gutedel, or French Chasselas; stands near the preceding. Wood gray, short-jointed, and tender growth; leaf small, heart-shaped, with fine nerves, of light yellowish-green color; bunches long and loose; berries medium size, and oval; ripens the

end of September. The fruit was destroyed by a sharp frost about the middle of September. I am of opinion that this grape is a seedling of the above-named Gutedel, and got there by some accident; but it may be the product of a hybrid from white and colored grapes growing there; it certainly has more the character of a *vitis vinifera*.

No. 15. *Vitis cordifolia*.—Bartlett grape. A pale-red or pink-colored grape; was found in the woods near Lexington, Massachusetts, by Elias Phiney, some years ago, and transplanted by Francis Alger, 34 South street, South Boston, into his garden; the soil is a sandy clay, location warm, and well sheltered by a tight board-fence. Wood reddish-brown, short-jointed, and of a robust growth; leaf medium size, heart-shaped, fine nerves, light yellowish-green color on both sides; bunches rather large, compact; berries round, medium, and sweet; ripens late; requires a warmer climate. See analysis.

No. 16 *Vitis cordifolia*.—An amber, or rather Traminer-colored wild native grape; seedling; has got by accident into the garden of Hon. Marshall P. Wilder, Dorchester, Massachusetts. Soil dry, gravelly loam; situation warm and sheltered. Wood light-brown, short-jointed, healthy growth; leaf medium size, heart-shaped, strong nerves, yellowish-green on both sides; clusters and berries of medium size, round and sweet; ripens middle of September. Not fruit enough for an analysis.

No. 17. *Vitis labrusca*.—A red-brown, mahogany-colored, wild native grape, originated in the woods, and was transplanted, three years ago, into the garden of G. W. Clark, Malden, Massachusetts. Soil stony clay; situation level and sheltered. Wood red-brown, short-jointed, vigorous growth; leaf medium size, round, strong nerves, and yellowish-green color; bunches medium; berries round and full; ripens middle of September; a good table grape. See analysis, page 46.

No. 18. *Vitis cordifolia*.—A Traminer-colored seedling grape, perhaps recently out of the woods; stands in Mr. Wilder's garden. Soil and location like No. 16. Wood red-brown, very short-jointed, healthy growth; leaf medium size, heart-shaped, fine nerves, and yellowish-green color; bunches medium; berries round; sweet and agreeable taste; ripens middle of September. See analysis, page 45.

No. 19. *Vitis æstivalis*—Sweet-water.—A white propagated grape, cultivated eighteen years by Mr. Newell Harding, 38 Chamber street, Boston, in his garden, a warm, well-sheltered situation. Wood golden-yellow, short-jointed, very healthy, vigorous growth; leaf small, heart-shaped, three-lobed, fine tender nerves, green on both sides; bunches large, compact, well shouldered; berries medium, round, very juicy and sweet; ripens middle of September, bears regularly every year. This grape is very profitable for table and market, and in a good sheltered position, with proper management, it will thrive anywhere. It requires to be laid down during winter, to be protected from severely cold weather. See analysis, page 47.

No. 20. *Vitis labrusca*.—A dark-brown wild native grape, from the woods, transplanted twelve years ago by John Butterfield, Bedford, Massachusetts, on the south side of his house; soil dry gravelly loam; situation sheltered and level. Wood brown, short-jointed, vigorous growth; leaf medium, heart-shaped, strong nerves, yellowish-green

on the upper, and yellow on the lower side; bunches large; berries round, large, and sweet; ripens by the end of September; a good and regular bearer. See analysis, page 47.

No. 21. *Vitis æstivalis.*—A red-brown, mahogany-colored wild native grapes grows in an open field belonging to John Wilson, Bedford, Massachusetts, running up on trees; soil sandy gravel. Wood brown, rather long-jointed, healthy growth; leaf round, small fine nerves; bunches medium size, compact; berries round, medium size, and of an agreeable wine taste; regular bearer; ripens by the end of September. See analysis, page 48.

No. 22. *Vitis labrusca,* the original Concord grape, a seedling from the *Vitis labrusca.*—This vine is now fifteen years old, and has borne regularly for seven years. It is one of the best hardy American varieties, ripening its delicious fruit in the most northern part of our country. It will improve its qualities every degree further south, wherever cultivated; in the South, West, and even in California, it gives general satisfaction. The wine, in body, flavor, and taste, resembles the sherry wine. The owner and propagator, Hon. E. W. Bull, of Concord, Massachusetts, deserves much credit for the introduction of this highly valuable grape. Its character consists of the following points: Wood brown, medium-jointed, very healthy, vigorous growth; ripens its wood well; leaf large, heart-shaped, three-lobed, strong nerves, yellowish-green on both sides; bunches large, well shouldered, rather loose; berries over medium size, oval, of a dark-blue color, thin skin, juicy, and of an agreeable wine taste; good for the table and wine making; it ripens about the middle of September; a good regular bearer; soil dry sandy loam; location open to the south, and sheltered from the north and northwest by a hill. See analysis, page 47.

No. 23. *Vitis labrusca.*—A seedling from the third generation from the original Concord vine. Soil and location the same as above. Wood light-brown, long-jointed, vigorous growth; leaf medium size, heart-shaped, strong nerves, three-lobed, and green on both sides; bunches well shouldered, medium size; berries medium, dark-blue, juicy, and very sweet; a good wine and table grape; ripens middle of September. See analysis, page 47.

No. 24. *Vitis labrusca.*—A seedling of the second generation from the original Concord vine. Soil and location as stated above. Wood red-brown, long-jointed, healthy moderate growth; leaf medium size, heart-shaped, three-lobed, strong nerves, yellowish-green on both sides; bunches well shouldered, a little above medium size; berries the same, round, dark blue, sweet, and juicy; good wine and table grape, ripens with the other two. See analysis, page 47.

No. 25. *Vitis labrusca.*—Sage grape, a red-brown wild native grape, found in the woods some years ago by Mr. Sage, and transplanted by Mr. R. W. Emerson, of Concord, Massachusetts, on the south side of his house. Soil dry sandy loam. Wood red-brown, long-jointed, healthy but moderate growth; leaf medium size, round, strong nerves, yellowish-green on both sides; bunches medium; berries of uncommonly large size, three berries weighing an ounce; round and tolerably sweet; ripens early in September. See analysis, page 48.

No. 26. *Vitis labrusca.* Dracut Amber.—A reddish-brown wild

native grape, a seedling from this family, found in the woods, and transplanted by Asa Clement, in Dracutt, near Lowell, Massachusetts, in his nursery. Soil a heavy wet clay; situation too much shaded and obstructed by trees. Wood red-brown, short-jointed, and healthy growth; leaf medium, heart-shaped, strong nerves; bunches rather large, compact; berries large, round, and sweet; ripens middle of September. See analysis, page 48.

No. 27. *Vitis cordifolia.*—A dark-blue wild native grape; grows in a swamp, owned by Salomon D. Case, Canton Centre, Connecticut. Soil, wet clay; situation much shaded by young forest trees. Wood dark-brown, medium-jointed, healthy, but moderate growth; leaf small, heart-shaped, fine nerves, yellowish-green on both sides; bunches not above medium, compact; berries round, medium size, thin skin, pretty sweet; ripens toward the end of September. See analysis page 50.

No. 28. *Vitis cordifolia punctata.*—A blue, copper-red speckled wild native grape; grows in the same swamp; situation the same as above stated, wet and shaded. Wood red-brown, short-jointed, healthy growth; leaf medium size, heart-shaped, fine nerves, yellowish-green on both sides; bunches medium, berries ditto, oval, and strong wine taste; ripens in the beginning of October. See analysis, page 52.

No. 29. *Vitis cordifolia punctata.*—A light-red colored wild native grape, speckled with copper-red. Soil and situation like the preceding. Proprietor, Mr. Case, of Canton Centre. Wood brown, very short-jointed, vigorous growth; leaf medium size, heart-shaped, fine nerves, yellowish-green on both sides; clusters large and compact; berries rather large, oval, sweet and juicy; ripens in the beginning of October. See analysis, page 52.

No. 30. *Vitis æstivalis punctata.*—A green wild native grape, dotted all over with snow-white specks, standing on Mr. Case's property. Soil and situation the same as No. 29. Wood brown, short-jointed, a good healthy growth; leaf large, heart-shaped, strong nerves, yellowish-green on both sides; bunches and berries medium size, the latter oval, sweet, and of an agreeable taste; ripens by the end of September. See analysis, page 52.

No. 31. *Vitis labrusca,* Hartford Prolific.—A dark-blue cultivated grape, a seedling from the Isabella. This is one of the earliest varieties, and therefore exceedingly well adapted to a northern climate; it ripens in favorable localities by the end of August; a good regular bearer. Wood brown, short-jointed, vigorous growth; leaf medium, heart-shaped, strong nerves, green on the upper and whitish-green on the lower side; bunches above medium size, compact; berries medium, round, and very sweet. I obtained a sample from E. W. Whiting, nurseryman, Hartford, Connecticut, who propagates largely from that grape for sale. See analysis, page 51.

No. 32. *Vitis cordifolia punctata.*—A dark blue, nearly black, wild native grape, speckled with copper-red; grows in the woods, in a valley near a small river, on the land owned by John Warner, near Florence, Massachusetts. Soil, sandy gravel, containing some loam. Wood light brown, short-jointed, and rather slender growth; leaf small, heart-shaped, tender nerves, yellowish-green on both sides; bunches medium; berries, large, oval, sweet, and vinous; ripens by the end of September. See analysis, page 52.

No. 33. *Vitis labrusca.*—A red Traminer-colored wild native grape, an old vigorous vine; stands in the garden of Theodore Clark, near East Hampton, Massachusetts, west of Mount Tom, on a level, open situation. Soil deep, sandy loam. Wood brown, short-jointed, of moderate growth; leaf medium size, heart-shaped, fine nerves, yellowish-green on both sides; bunches and berries of medium size, the latter round, and of a pleasant wine taste; ripens middle of September. See analysis, page 52.

No. 34. *Vitis cordifolia.*—A dark-blue, almost black, wild native grape; grows on the western slope of Mount Tom, on a wet, cold, clayey soil, and runs along a fence, and on trees and brushes. The land belongs to Frank Clark, near East Hampton, Massachusetts. Wood dark-brown, short-jointed, of healthy, but moderate growth; leaf small, heart-shaped, fine nerves, green on both sides; clusters of medium size, very compact, a little shouldered; berries small, round, and of an agreeable vinous taste, slightly acid, but not unpleasant; ripens in the early part of October. See analysis, page 52.

No. 35. *Vitis sinuata.*—A dark-blue wild native grape, one of the best specimens of the frost grape; grows near the one just described. Wood brown, very short-jointed, tough, vigorous growth; leaf small, heart-shaped, three-lobed, green on both sides; bunches long, compact; berries small, round, if not compressed, rather crisp, or acid, but not disagreeable; ripens in the beginning of October. This grape deserves propagating and improving, as its juice contains properties desirable to be mixed in small quantities with other varieties in making wine, obviating flatness, and rendering it tenable.

No. 36. *Vitis labrusca.*—A red-brown wild native grape, found in the woods, and transplanted, or set out, by Mr. Clark, in his garden, southwest of Round Hill. Soil, a good sandy loam; situation, warm and well-sheltered; grows up on an apple tree. Wood brown, medium-jointed, vigorous growth; leaf medium size, heart-shaped, strong nerves, yellowish-green on both sides; bunches and berries of medium size, oval, and pretty sweet; ripens towards the end of September. See analysis, page 52.

No. 37. *Vitis cordifolia.*—A dark-blue, nearly black, wild native grape; stands on the edge of a forest, in a swamp meadow, at the top of the Orange mountains. Proprietor, A. O. Moore, Orange, New Jersey. Soil, wet clay. Wood dark-brown, short-jointed, thrifty growth; leaf medium size, heart-shaped, strong nerves, yellowish-green on both sides; bunches medium size, shouldered; berries rather below medium, oval, and of an agreeable wine taste; ripens the first part of October.

No. 38. *Vitis labrusca.*—A dark-blue, wild native grape, found in the woods, and set out by Charles Dickinson, of Verona, Essex county, New Jersey, on the southeast side of his house. An old vine; no care is taken of it; is supported by a rough frame. Wood greyish-brown, short-jointed, healthy, vigorous growth; leaf medium size, heart-shaped, strong nerves, yellowish-green on both sides; bunches medium, berries large, round, sweet, and pleasant wine taste; ripens in the beginning of October. Soil wet clay and very stony; situation high and open, on the top of the Orange mountain.

I have been particular, in noting these varieties, to describe their character as clearly as possible with regard to their wood, growth, fruit, and its shape, color, and taste. I did not find much difficulty, but have been often at a loss how to make out the leaves, which were often of different shapes and colors on one and the same vine; for instance, there were on a vine large heart-shaped leaves, deeply cut, with three to five lobes, long stem, stout ribs and nerves; and, again, leaves almost square, lobes hardly discernible, short stems, small, tender ribs and nerves; and some round, without lobes, long stems, fine ribs and nerves; some on one side, heart-shaped, with one or two pretty sharp cut lobes, and, on the other side, round and smooth. The same variation I found in the color of the leaf, but here it was merely the influence of the light, sun, and shade. In shaded localities, under trees, &c., where the sun and light were obstructed, the color would be a bright green, as it appears on the best improved European varieties. According to circumstances, as they were under this influence, they would change their colors, and the more favorable their situation in this respect, their color would change to yellow, and, in free, open situations, would be for the most part a yellowish green on the upper side, and several shades deeper, sometimes clear, bright yellow, on the lower side, which is in most cases their fixed color. But there are some exceptions again: The most of the worthless offsprings from the *Vitis cordifolia* have clear, green leaves, while the better varieties have that yellow hue. There is only one family of which the leaf is found invariably green; it is the lowest and least useful of all—the frost grape, or *vitis sinuata*. On some of the seedlings from the fox grape, *vitis labrusca*, the white color predominates, instead of yellow; the upper part of the leaf will be of a white hue, while the lower side presents this peculiar downy character, completely white.

According to my instructions, to investigate and examine the wild native grapes with a view of testing their respective qualities, and to note those which show good qualities for wine or table grapes, in order that they might be propagated and improved, and as those which I marked will, in proportion as they are submitted to a systematical course of development, change their original nature and habitus, so the proper time to record their character will be when they shall have attained the highest point of improvement, therefore, I concluded not to take notice of the numerous variations in the form or construction of the leaf, and difference of their colors, but only to describe their most common forms, namely, round, heart-shaped, large, medium size, or small, and the color, yellowish, whitish, or green.

The quality of their fruit, as exhibited by analyzing samples, is, in all cases, capable of improvement, the degree of which will be in proportion to the advancement of the vine itself; therefore, the analysis shows only the fundamental properties of these specimens, and the task to develop and progress upon this basis is reserved for the practical propagator and œnolog. He will arrange these varieties to answer his own purposes; by a thorough system of rational culture, increase their saccharine properties, restrict the predominance of acidity, and bring the whole to a proper condition.

By due consideration of the soil, position, and climate, a good esti-

mate will be obtained, from the result of the analysis, as to the capability of the wine. For instance, the fruit of a vine which grows on a wet, cold soil, in a low, shaded situation, and in a severe and rough climate, contains eight per cent. of sugar, the vine thus possessing the points required of a good grape; yet, in most cases, by being translated to a better soil, position, &c., with proper culture, it will attain from twelve to sixteen per cent., and, of course, produce a superior wine. Analysis, therefore, gives a surer basis to judge and select wild grapes than the simple taste, which is as various as deceptive; at the same time, it will bring to notice such varieties as, differing from the common and fashionable sweet grapes, contain precisely the properties essential to make several of the most highly esteemed wines.

Late frosts in the spring, and especially some sharp visitations in June, checked the grape-vines, and totally destroyed those on level parts of the country; only in elevated, sheltered portions was there any saved, and far less than the usual crops. My investigation was, therefore, limited to such favored locations, while even here the means allowed were not sufficient to enable me to extend my labors to a larger scale. The result is highly valuable and stimulating for the culture of the grape. I found, in general, a lively interest among all classes for this noble and lucrative branch of horticulture. The intention of the Patent Office to encourage the culture of the vine through the whole country, by collecting and disseminating knowledge relating to it, and the best methods of wine-making, was well appreciated, and especially so on account of the direct way which had been chosen. Personal observation and instruction will often, in one hour, be more beneficial than long study of scientific essays, which are, for the most part, written in too high a style to be clearly understood by the plain, practical man. By those interested in this pursuit earnest wishes were expressed that the Patent Office might continue its noble efforts.

In a country like ours, blessed with everything to make life pleasant, and possessing a proper soil and climate for every plant, why, otherwise so favored, should man be deprived of the real essence of life, wine? True, this incomparable nectar is not unknown here, for many thousand American eagles of gold cross the Atlantic annually to bring it to us; but this privilege is attainable only by a few, while the mass of the people may not receive this best gift of Nature. Substitutes have been invented, but they are poor indeed, compared to genuine wine, which makes man social, contented, and happy, while those mixtures and drugs, at once exciting and stupifying, demoralize him. As wine is a pure beverage which Nature furnishes, its use should be attainable by every one; while it inspirits the youth to all that is fair, good, moral, and grand, it stimulates the man in his labor and occupations, makes him a brave husband, father, and citizen, and brightens the evening of age. As wine has so beneficial an influence on the nature and character of the individual, it will likewise exalt the condition of a whole people; consequently, there is reason why we should exert ourselves to introduce the general culture of the grape in our own country, as has been done for centuries in other lands.

For the use and comfort of a single family, a small piece of ground, by intelligent management, will produce sufficient, while if the area be extended, the profits obtained will prove a liberal encouragement. Many hundred acres, exhausted by our bad management, but yet containing enough mineral substances to support the grape-vine, might, with little expense, be converted into vineyards. Those black and barren hills, gloomy as they look, will, in many instances, afford desirable situations for this purpose, and can thus be changed to profitable plantations, highly ornamental to the country. By a proper selection of the position and of the varieties adapted to the climate, the grape-vine may be successfully cultivated in every State of the Union. It will flourish wherever corn will grow. But before embarking in this enterprise, it is necessary to understand the principles of the culture and management of the grape, and the mode of making wine.

CULTURE AND MANAGEMENT OF THE GRAPE, AND THE MODE OF MAKING WINE.

BY JOHN F. WEBER, of WASHINGTON, DISTRICT OF COLUMBIA.

PROPAGATION OF THE GRAPE, BY LAYERS, CUTTINGS, EYES, AND SEED.

Layers.—Supposing the vines are old, and growing wild in the woods or fences, the best branches should be selected, those which have made strong and well-matured wood. They must be bent down to find where the last year's growth reaches the ground, in order to see what space they require; the length and number of the shoots will give the best indication. The land should be cleared of stones, stumps, sod, and roots, trenched to the depth of from fifteen to eighteen inches, and enriched with well-rotted compost. Heavy and stiff soil needs to be meliorated with sand, to the texture of good garden earth, after which small trenches have to be dug for each single shoot, about a foot wide and six inches deep. The branch is now taken down and secured to the ground by a strong wooden peg with a hook. It is not necessary that the branch should be prostrated quite to its root, but precaution must be taken not to break it by bending. The shoots of the last year's growth are then taken and deposited singly, each in a trench, fastened by little wooden pegs, care being used that they lay close at the ground. These shoots must have been previously examined, all dry and immature wood cut off, and only the sound, well-ripened wood employed. The best time for that operation is when the buds have made two leaves. They are left in this position, uncovered, till the eyes have attained three or four inches growth, when a regular circulation of the sap will

be effected; they are then covered with fine, pulverized earth, about an inch. It is very interesting now to observe how quickly callus is formed under each eye, from which small roots will emanate in the course of three or four days. In eight or ten days the formation of roots will be completed, when two inches more of earth may be put in, and in a fortnight after another inch, which is the final covering. In dry, sandy soil, or when the summer is unusually hot and arid, it is prudent to mulch these young plants at once, two or three inches, after the last covering, with straw, leaves, or tan-bark. This will keep the ground moist, and protect the young, tender roots from becoming dry and burnt. Late in the fall, when the plant is in a dormant state, the branches which have been layered are cut off close at the old wood, carefully taken up with a garden fork, so as not to break the roots, and divided. There will now be obtained from each eye a strong, well-rooted plant. These young offsprings are now taken and heated in the ground, where they remain through the winter, or till they are wanted. The branch of the old vine remains in its bent position; the next spring shoots will grow out near where the layers had been cut off the year previous; when they have made about twelve inches in growth, the stump or basis of these young shoots is covered with good rich soil, about six inches, in order that roots may emanate to render it independent of the old vine. They are left to grow during the season. The next spring they are layered again, and another set raised in the same manner. By this manipulation, vigorous plants can be propagated from an old vine every second year, and will bear the second year after planting. In regard to their strength, and the development of their root system, they are preferable to any propagated from eyes or cuttings.

Making layers from vines in a vineyard is far more easy, as the ground is already in a good condition, and the vines in a more active state. In the time of summer pruning, one or two strong shoots are left, as close as possible to the ground, on the vines from which layers are desired; they remain hanging down through the summer, undisturbed, and the next spring are treated as already described. It is important, in all cases, to let them hang loose, till all the eyes are well developed, and have made at least half an inch growth. This method is always sure, as it corresponds with the principles of the physiology of the grape-vine, which, like other young plants, requires for its developement an equal share of light, warmth and moisture.

Propagation from cuttings.—This is a very simple procedure. In the fall or winter, shoots are selected from the strongest and best ripened vines, cut three or four eyes long, tied together in bunches of from one hundred to five hundred pieces, and either put in the ground and well covered with earth, or kept in a cellar during winter, covered with sand. In the spring, as soon as the ground is dry, a partly shaded spot is chosen for a plant-bed. The soil should be dry and warm; it requires trenching about two feet deep, and meliorating with compost and sand till it compares well with hot-bed earth. This plat is laid off in beds four feet wide, and two feet are left between for a path. There will be room in such a bed for four rows of cuttings. In order to plant them at equal distances, the ground should be measured and a line drawn. The wood, on the lower end of the

cuttings, should be cut off close to the eye. To keep them moist, it is well to wrap them in a piece of old cloth, and take up only one bunch at a time. There is an instrument generally used for that purpose, which greatly facilitates planting; it is made of a piece of wire, half an inch thick and two feet long, a cross handle at one end, and the other flattened and bent to an angle of 45°. In the flat end an opening is prepared in the shape of a V, wide enough to admit the cutting. With this instrument, called a plant-stick, the cutting is pushed into the ground in a slanting position, and only one eye left out, near the surface. It should never be inserted deeper than four or five inches. In dry weather, the plants require watering every second night, till they have formed roots and are established; they must be kept clean, and no weeds allowed to grow in the bed. In the fall, they are taken up carefully, with a garden fork, and heeled in the ground again during winter. Next spring, they may be removed to the vineyard, and will bear the third year. But if strong-rooted vines are wanted, these rooted cuttings have to be planted once more in the bed, but require now at least a square foot of space, and their last year's growth to be cut back to one eye, and taken up again in the fall and heeled in.

Propagating from eyes.—This can be done only under glass, either in a propagating-house, green-house, or hot-bed, as otherwise no good results can be expected; still, if trouble is not regarded, eyes may sometimes be propagated in boxes, or even in the open ground.

Strong and well-ripened canes should be selected. They may be cut eight or ten eyes long, heeled in sand till wanted, and put in the cellar, or in any place where the frost cannot reach them. In order to get large plants the first season it is necessary to begin their propagation early; February is generally the time when they are started. If a propagating-house with a sand bed be at disposal, little furrows are made in the sand about half an inch deep, and two inches apart, in which the eyes are placed horizontally; they are then covered with sand and drenched well; a temperature of from sixty-five to seventy degrees must be maintained till they have completely rooted. In common green-houses pots are generally used; they may be of different sizes, but should not be smaller than two pints. After some broken pieces of crockery, oyster-shells, &c., have been put in the bottom to secure a good drainage, they are filled to half an inch of the top with earth, and four to six eyes are stuck in vertically, so that the point of the eye just peeps out. They are well drenched, and placed in the warmest part of the house. In hot-beds pots are likewise more convenient than open beds. They should be constructed as usual for raising plants, with a bottom heat of from fifty-five to sixty degrees. The pots with the eyes are put in dry saw-dust, or tan-bark, and raised within six inches to the sashes. In order to preserve an even temperature, constant watching is necessary, and every opportunity, when the weather is clear, and the atmosphere warm, should be improved to give air so as to prevent mold and rot. Straw-covers and board-shutters must be provided for cold nights and stormy days. In proportion to the development of the plant must be the quantity of air admitted, and finally the sashes will have to be removed during the day, and only kept on in the nights. When at last the spring has fairly opened;

when night-frosts have ceased, and the soil has become warm and dry, a shady place is selected, soil suitable for the striking of cuttings prepared, and the young vines are transplanted into the open ground, about a foot apart, care being taken not to set them too deep; three inches will be sufficient.

It is well to mulch them at once, to secure an even temperature and moisture for their tender roots. Straw or leaves are the best material for that purpose. If properly attended, they will make a growth of from six to eight feet, sometimes as much as twelve feet, the same season, and will bear the second year after transplanting. They may remain during winter in their bed or nursery, and be transplanted at once the next spring in the vineyard. This method applies to all young plants grown in the propagating house, green-house, or hot-bed. The best earth to strike eyes in is a mixture of equal parts of well-rotten turf, or sod, soil, or leaf-mold, from the forest, and washed sand, with a little addition of fine bone and charcoal dust.

Propagation from seed.—The best ripened bunches should be selected, the seeds extracted, and dried in a shady, airy place. When dry, they should be put in a little bag, and hung up till wanted. A spot for a seed-bed should be selected on a dry, airy, and shady piece of ground, prepared as for cuttings, or eyes. The fall is the best time to sow the seed. Furrows, half an inch deep and one foot apart, are made, the seed dropped in, about two inches from each other, covered with washed sand, and finally with straw or leaves. In the spring, when the night-frosts have ceased, this cover is removed, and pine or hemlock boughs put on instead till the seed has sprouted, and young shoots make their appearance. Nothing else is required through the summer except weeding, and occasional watering at night in dry weather. Late in the fall the young vines are taken up with a garden-fork, and heeled in again. In the spring they are cut back to one eye, and replanted a foot apart, in which situation they remain undisturbed during the season.

But, as the grape-vine seldom reproduces its character in its offspring from seed, and is rather changed to all possible variations, there can be no confidence that such seedlings will be of the same type; sometimes they will be of a first-rate quality, and generally of different colors. The well-known and highly-esteemed Concord grape, for instance, is of a dark blue color; yet from this Mr. Bull has raised a white seedling of superior quality, and other seedlings of first-rate qualities, varying in color from a light Amber of all shades to a dark Traminer, while several, again, presented the same color as the original vine. Among seedlings, also, are male plants, which will not produce fruit at all. These are distinguished by their small, long eyes, lying flat on the wood, while fruit-eyes may be recognized by their short, thick, shouldered appearance. In order to find out what may be expected from them, they should be closely examined the second year, and those which promise best brought in a bending situation, to induce the formation of fruit-buds. They are taken up in the fall and planted in pots holding about six quarts, and their shoots cut back to three eyes. Until the middle of February they are kept in a cool place, when they should be put under glass, either in a green-house or hot-

bed, to be started. By bending the cane till the young shoots are out one inch, and cutting a ring from the bark below the upper eye, they will sometimes bear that season and show their true character. If there is no such convenience as a green-house or hot-bed, the propagator can only wait till the weather becomes warm, and in the meantime may place them in a sunny, sheltered corner, near the buildings. Of course, no fruit can be expected that season.

If, in either case, no fruit appear, the canes should be bent as soon as the wood begins to ripen on the lower part, and kept in this position till fall, when they are pruned back to six eyes. In the following spring this cane is bent again, and fastened on a stick, to remain so during the season. All the side shoots and new wood, except a leading cane, is pruned off during the summer, and only a single bunch allowed to grow. Seedlings which have satisfactorily fruited and proved of a generally good character, may be set out and grown as the sources of further propagation; they are now new varieties. Those in the seed-bed, or nursery, should be examined again, and such as compare well with the fruited specimens may be planted out in the vineyard; the rest, which show less good points, should be grafted, or budded, at once.

The object of taking up and transplanting these young propagated grape-vines every season is to get a chance to regulate their formation of roots, to cut back single leading roots and make them grow more fibres, which are less important to the rapid and vigorous growth of wood than to the fruit and its quality.

IMPROVING THE GRAPE-VINE, BY LAYERING, GRAFTING, BUDDING, AND HYBRIDIZING.

Improving by layering.—This, in the beginning, is performed as before described. After the plants obtained from layering off have been transplanted and grown one year, they are cut back in the fall to four eyes, and the next spring layered down again, and treated in the manner above referred to. In the fall they are taken up, heeled in through the winter, and set out again in the spring, being pruned back to one eye; the following fall they are cut back to six eyes, and layered down once more the next spring.

When this operation has been performed several times, the character of such a vine will be greatly changed, and the quality of its fruit improved. By this manipulation, another system of roots is obtained, the wild nature of the vine tamed, and, in consequence of its fine cellular texture, it will form larger fruit buds, the cluster will be heavier and more compact, the stem of the berry more tender, and, acquiring more and stronger fibres on the basis, the berries will not again drop off, the skin will become thin, and the pulp soft, juicy, and more sugary.

This method has been practised for centuries in parts of Germany and France, with the exception only that such plants were allowed to

grow and bear several years before they were layered again. All those first-class varieties, the Gutedel, or Chasselas, Muscats, Traminer, Malvasier, Riesling, &c., have thus been brought to their present high state of perfection.

Improving by grafting.—Grape-vines which have good roots, growing on houses, arbors, or such places, where stirring and breaking the surface-soil is omitted, and yet better fruit, or a different variety, desired, and where, also, shade is an object, may be successively changed by grafting on seedlings and other vines of inferior quality, to turn them to better account in the quickest possible time. This operation is best performed in the spring, when the buds have developed to two leaves, and when the sap does not circulate and flow so rapidly. However, the grafts have to be cut in the fall, when the vine is in a dormant state, and either buried in the ground, or kept in a dry, cool cellar, through the winter.

Grafting is performed in the following manner: The soil is removed about four inches deep, the vine sawed off, and the cut nicely pared with a sharp knife, a cleft is now made, two or three inches deep, into the stump or stock, which is kept open by a wedge till the graft is set; the graft should have two or three eyes, and be cut exactly to fit the cleft. The lower eye should be close to the bark of the stump, and the bark of both stump and graft should fit well together. The wedge is next taken out, the whole wound well covered with grafting wax, and the soil brought back again, and mulched with straw or leaves. All the buds are allowed to grow undisturbed through the summer, but the water shoots from the stump must be kept down; in the fall one or two canes are left, and pruned back to six eyes; all other wood is cut off.

There are sometimes cases where vines cannot be grafted so low, and perhaps several feet above ground only. If so, another method is adopted: The top of the vine is cut off likewise where the graft is wanted; then a three-inch vertical cut is made through the bark, which is lifted up; the graft, with two eyes and three-inch wood below, is cut half through horizontally back of the lower bud, and from the point below diagonally up to the cross cut. This wedge is pushed down under the bark, after the cross cut has been made to fit the stump or stock, that is, cut in slanting till the graft gets a vertical stand. It is then tied up with bass, covered thickly with grafting-wax, and finally wrapped in a piece of rag. The tying requires particular attention, as the air must be entirely excluded from the wound. Another method is practicable on young vines, seedlings, &c. The vine is cut off diagonally, and also the graft or scion; both cuts should be at least three inches long, and fit exactly together, the graft is laid on, tied with soft bass, and the whole dressed with grafting-wax, as above. When the vine is much thicker than the scion, the bark and some wood are cut off on one side only; the graft is cut diagonally; both cuts should match and fit, so that the *inner bark of the scion may lie exactly on the inner bark of the stump or stock.* This is the essential part of grafting, and in all cases should be observed. The union takes place first between the inner bark and wood, where callus is formed for new wood. The whole ope-

ration must be done very quickly, so that the circulation of the sap will not interfere with putting on the wax.

Improving by budding.—The proper season for budding grape-vines is the latter part of August, when the buds of the current year's growth are plump and the young wood is becoming firm. If possible, two or three year old wood should be chosen, in which to set the buds. Thrifty shoots are selected, and the soft eyes on the upper end rejected. The bud is cut out about two inches long, with as much bark as possible. In taking out the wood, a thin slice should be left at the basis of the bud, so that its roots may not be injured. Having prepared the bud, an upright incision is made in the bark about an inch and a half long; on the top of this a cross cut is made, forming a T, when the bark is raised up, the bud is pushed in, tied carefully with soft bass, and covered with grafting wax, only the eye being left exposed to the light and air. When the bud has taken, the old wood is cut off above it in the fall. Another mode, for which the spring is the proper season, is often practised with good success. Having ready the shoots, the upper and lower end, from which buds are wanted, the eye, with an inch of wood on, is cut off from the cane, together with half of the wood back of the eye. Then a similar cut is made in the stock where the eye is to be inserted, so that it shall fit exactly. The eye being set in, the whole is waxed and tied up as before.

Budding grape-vines is based on the same principle as budding fruit trees, roses, &c. By budding, different varieties may be produced on one vine, and, if chosen with regard to their maturity, blossoming at the same time, accidental hybrids may be obtained.

Improving by cross-breeding.—This method requires much time and attention, and cannot be much depended on, unless the plants are grown in a green-house or grapery, which is seldom to be found in connection with a vineyard. Such experiments are rather out of question with the practical grape-grower, as he is generally fully occupied with the work of the vineyard. But it is very important that those who have more leisure and proper skill should employ themselves in this highly interesting business. Or, still better, that it should be executed at governmental or State expense in experimental gardens and vineyards. It is highly appreciated, that the United States Patent Office has already commenced to carry out such a plan, raising and creating new varieties of grape-vines for distribution through the whole land, which will promote and encourage grape culture. But this is only a beginning. In addition to the propagating houses, a vineyard is wanted, where these new varieties can be tested and their character observed, in order to decide what soil and climate suit them best.

To obtain an improvement on a new variety, two well-known vines are selected; when they blossom, the anthers must be cut out, with scissors, from the blossom of the vine to be improved and impregnated; and as soon as the blossom is expanded on the other from which a better variety is intended, the pollen is collected with a fine brush from a well-blown flower, and applied upon the point of the pistil on the other vine. The seed of such a cross-breed will produce plants of a new variety.

CULTURE OF THE GRAPE-VINE IN THE VINEYARD.

Proper soil and position.—The best and most natural soil for the grape-vine is a dry porous lime-stone; the next best, a deep, loose, stony, loamy soil, even sandy, if it contain some loam and marl, and if a good subsoil be practicable. The soils upon rocks are favorable to the growth of the vine, as the roots find in the clefts the very essence of life—a loamy substance, containing phosphates. The less vegetable substances a soil contains, the better is it for the grape-vine.

In regard to position, a high, free, well-sheltered one, on the south-east slope of a hill, is the best; but level or rolling land may be made available by planting groups of pine trees on the northern part, to break the cold, strong winds. A vineyard, in all cases, should be open to the south and east, admit a free circulation of air, and not be under the influence of miasmas, dampness, and stagnating waters, or exposed to cold north winds.

Preparation of the soil.—As there are many instances where soil of the above description, in a naturally good condition, cannot be found, it must be meliorated, if position and other circumstances will justify such expense.

Strong, heavy soils require loosening, so that the atmosphere may have free action upon them, and therefore must be trenched. This is done in the following manner: on the lowest part of the land a line is drawn across, and six feet wide marked off; the top-soil, according to its richness, is taken up, perhaps from four to eight inches deep, and placed somewhere near, but out of the way; then a three-feet wide, and three to three and a half feet deep, trench is opened, and the earth thrown forward. This is the beginning. Now another three-feet wide strip is cut out, and the earth thrown into the open trench; three feet wide are marked for the next trench, and the top-soil from that strip thrown upon the first trench, which is filled up level with the surface; coming up at last with this work to the other end, there will be one trench and six feet wide surface left to be filled up and covered with the earth taken out of the first trench and the top-soil from the first six feet wide, which were thrown forward out of the way. This has to be carted up, first the subsoil for filling the trench, and next the top-soil to level with. On such lands the top-soil should never be thrown into the trench and covered with the raw subsoil, as the young plants have to depend on it for their first nourishment, till the subsoil has changed its texture, by the action of the atmosphere and manure, to a mellow, productive condition.

If the resources of a forest are near, where leaves, pine straw, rotten mast of branches, &c., can be obtained, all these should be collected, as the rough material to be thrown in the bottom of the trenches, and leaves, &c., mixed in layers with the subsoil. The fertilizing capacities of such substances are not of much account, but the advantage thus derived keeping the soil loose, to admit light and the action of the atmosphere, is all important. Whatever may serve that purpose, as stones, half-rotten stumps, &c., found on the land, and necessary to be cleared off, may be thrown in the bottom of the trenches. If sand, the

coarser the better, be convenient, it would be well to put it a couple of inches high on the top of such subsoil, as it will add greatly to its improvement.

Should the land require draining, this must be done before trenching; horse-shoe tiles, of four-inch diameter, will answer, but they should be laid at least four feet deep, with sufficient fall.

On a less tenacious soil, with a gravelly, loose subsoil, trenching may be performed by horses and plows, which considerably lessens the expense. A double Michigan plow and one of the largest subsoil plows would be required, and two double teams for each; the double plow will throw up a furrow about twenty inches deep, while the subsoil plow following it will loosen and deepen the soil in that furrow from twelve to fifteen inches more. If only two teams are at disposal, they must be changed from one plow to the other, going round first with the double plow, and following in the same furrow with the subsoil plow. By this mode of trenching, the good surface soil will inevitably be buried by the subsoil, and therefore it must be meliorated with compost. Naturally good soils seldom need trenching; all that is necessary is to remove all obstacles from the surface, spade or dig the ground over to the depth of a foot or eighteen inches, and plant the vines.

Manuring, and the best manure for the grape-vine.—The mineral manures, in consequence of their ingredients, have the most effect on the quality of fruit, and keep the soil in a porous, mellow, and productive condition; while animal and vegetable manures encourage the formation of wood too fast, and make the vine tender and subject to disease. Never should fresh animal manure be brought into the vineyard, but always be first composted with sod, or good surface-soil and charcoal dust, well rotten; and even then only used when young tender plants absolutely need support. On first-class land no manure is required, except a little well-prepared old and mild compost, with which to start the young plants, and to encourage their formation of roots. But heavy soils, after they have been trenched, should be improved by sowing leguminous plants on them before planting the grape vine, and receive a good dressing of lime. Peas, vetches, or buckwheat, would probably answer best; they should be sown pretty thick, and early in the spring; when they have grown to about six inches, it is time to apply the lime; twenty bushels per acre will be the least quantity, but more may be put on, if convenient. The lime should be strewn, in a well-powdered state, early in the morning, when the dew is on the plants. After the crop has blossomed, it is plowed under about four or six inches deep, and a crop of turnip may be raised on it the same year, partly paying the expense. By such treatment, and the application of lime, the soil becomes mild and admirably adapted to support the grape-vine; it can be kept in a highly productive condition by alternate application of green manuring and lime, and once in about five years of eight hundred to one thousand pounds of bone dust, all of which must be plowed under and mixed well with the soil.

Sandy soil must be treated in the same way, marl and leached ashes being added, to make it more consistent. Ashes and lime should never be applied with bone dust, as they will weaken its fertilizing capacities by driving out the ammonia. The ashes and lime, while they

furnish the plants with oxygen, act at the same time, through their salinous substances dissolving and cooling upon the soil, to keep it moist; the bone dust, again, contains the most nourishing elements, which, in addition to the other substances, promote the prosperity of the grape-vine. When the planting of a vineyard has been concluded, resources should be explored whence proper material may be obtained for manure. The first step is to begin with a compost heap, which should be of such dimensions as to correspond with the size of the land to be prepared for a vineyard. A large quantity of charcoal dust, the unmarketable refuse, to be had, in most cases, for nothing, if carted by one's own team, with leaves, pine straw, and such stuff, which can be scraped off in the forest, muck, &c., should be provided; anything raked and swept in the yards, barns, and stables, will be acceptable; nor should be forgotten a large cistern to gather all the liquid manure from the animals. When all these materials are at hand, the construction of a compost heap may be commenced by a layer of sod, muck, or good soil, a foot high; on this, stable manure a foot high; this again covered with charcoal dust two inches high; now again six inches of good soil, sods are best; on this, manure, leaves, &c., and again charcoal dust and sods, or muck, manure, or leaves, &c.; charcoal dust continued till the heap gets six or eight feet high, when a new addition has to be begun. The heap should be kept level and not too small on the top, so that the air and rain may equally penetrate it.

In two or three months this heap may be worked over, by which its contents will become well mixed and fit for use. But it will improve by age. It is often surprising how much material can be collected for this purpose, and how clean and neat the while a farm-yard appears! In the same proportion that the land is made productive, so the barns and cellar will expand and fill up with treasures.

Planting the grape-vine.—Before beginning to set out the plants, the land should be laid off in squares, according to its size, perhaps from one to two or more acres, with convenient roads between for the passage of teams and carts. On side-hills, impassable for teams, these avenues may be narrower. Next to be determined is whether the vines shall be trained on trellises or stakes. This will indicate how much room they require. In a northern climate, trellis culture is preferable, while in the south stake and bow training are more advantageous. The reason for the northern mode of training, is to keep the vines as high as possible from the ground, as its dampness causes rot and mold on the lower fruit. But in a hot climate, it is desirable to have the ground shaded to retain the moisture. Therefore, in this case, the vines should be trained low and on stakes, and the spur and bow system practised. In regard to the space allowed them, six by eight feet will be about the proper distance for trellis culture, and four by four for stake and bow training. In the first instance, nine hundred and seven plants to the acre will be required, and in the second, two thousand seven hundred and twenty-two. The rows should run from east to west, to receive the first and last rays of the sun, at morning and evening, on as large a surface of the ground as possible. After the course of the rows has been decided, the distances for the plants in the rows are measured, and a stick inserted where the vine is to be

planted; then the holes are made, which should be a foot deep and three feet wide. A shovelful of good mild compost is put into each hole, and well mixed with the soil; being ready for planting, the different varieties are counted over, and the places for each selected. Every variety has its own merits.

To make a good wine, free from that peculiar taste which wine has when made from one variety, several kinds must be planted, selected with regard to their qualities; one to furnish bulk, another to give body and consistence; one to be rich in sugar and vinous acids, another to furnish flavor, another aroma, another color, and still another to unite all these qualities, &c. The nearest proportion of one to the other of the varieties here named, or rather their requirements to make 100, would be: 60, 20, 3, 3, 9, 5.

Of rooted plants layers are the best, they having completed the formation of roots, and being able to bear the second year after transplanting; sickly, tender, and poor-rooted vines can be rejected, as there is a chance to examine them. It requires two persons for planting, one to take the plant and spread out the roots evenly in the hole, while the other brings in the soil, well pulverized, shovel by shovel, and keeps gently moving the plant up and down, in order that all the fibres may come in contact with the earth, and no cavities be left among them. After the hole is filled, the earth is pressed down gently with the foot, and thus is the work finished.

When no rooted plants are at disposal, and resort must be made to cuttings, they should be five eyes long; the instrument described on a previous page will be the most convenient to plant them with. Of course, no holes need be dug, but the places will have to be marked by a stick. They are planted by couples, that is, two at a place, and pushed in, slanting, to the last and uppermost eye, leaving one eye only above the surface. In the north, the spring is the best time for planting; while in the south, the fall is best for rooted plants, and spring for cuttings. Rooted plants have to be cut back to two eyes, the young shoots of either are left without tying the ensuing season, as they will get a stronger body by being left loose, and in a bending position.

In northern countries, especially in the New England States, there is, at present, but little choice among varieties; the Diana, Delaware, Isabella, Catawba, &c., will not ripen there; with a few exceptions, in very favored localities at least, their maturity cannot be depended on in general open-vineyard culture. But the Concord, Hartford Prolific, and several of those investigated and noted contiguous varieties, can be relied on, such as Case's Crystal, the Bartlett, Dracut, Amber, &c. Together, if cultivated well, they will produce a pretty fair wine. In milder climates there is less difficulty in choosing the proper varieties for a good wine; besides of several highly improved native grapes, German and Hungarian varieties may be cultivated with success, if attention be paid to their habits and qualities. In all cases their time of maturity should be alike, that they may be gathered simultaneously.

Pruning and training the grape-vine.—This is one of the most essential points in grape culture, as development and productiveness are

directly affected by it. The proper knowledge can only be acquired by practice and experience. It would be prudent for an inexperienced person to engage a practical vine-dresser to prune his young vineyard once or twice, and accompany him and take lessons, rather than to experiment himself according to the wild, unsound theories prescribed by professional book-makers. It is easy to give rules in general reliable, but there are often circumstances in which none of them can be applied, when the theorist is no longer able to decide his course. Indeed, it requires practical knowledge to prune and train a grape-vine well. Much has been done, in those countries of Europe where the grape-vine is cultivated, for the education of practical vine-dressers, either by their respective governments or by agricultural societies, schools having been established especially to promote that branch of horticulture.

The best time to prune the grape-vine is late in the fall, or, when the weather permits, during winter, as the plant is then in a dormant state. The young rooted vines, or layers two years old, which have been cut back to two eyes by transplanting, will have made two shoots during their summer's growth; these are pruned back, if trained on trellises, to six eyes each; if on stakes, one to six eyes; the short end, called the spur, to furnish bearing wood the next year, and the long end, or bow, to bear fruit. On cuttings, the single shoot which they produce the first season is pruned back to two eyes, and so all young and tender-rooted vines. During the ensuing summer nothing more is to be done than occasionally to tie up the young, growing shoots, and keep the weeds down by plowing or hoeing. Fruit-bearing branches must be nibbed back two leaves above the bunches. A crop of turnips, carrots, or cabbage may be raised that season, which will facilitate the growth of the young grape-vine.

The second year, on the strongest vines—now four years old—both ends are lengthened by six eyes from the young wood, and the rest cut off; from the side shoots all new wood is removed, except one spur of two eyes on each shank, for making new wood; the following spring, these two shanks are tied horizontally on the first wire or lath of the trellis. During their summer's growth, all the shoots on the bearing canes are nibbed back to the second leaf above the fruit, as soon as the fruit has well set, and water-shoots broken off as soon as they appear. The shoots from the lowest buds on the spurs, after they have made two feet growth, are pinched in two, and the other shoot is allowed to grow; all the young shoots must be tied up several times through the season. The third year, the longest canes from the spurs are trained up to the third wire, or lath, or both, of the trellis, and cut according to the length required, to permit them to be tied on one foot long, horizontally. Every second bud on the vertical part of these canes is broken out, the rest left for fruit spurs; and the short shoots on the spur are pruned back to two eyes, to bear. After this, the vine must be kept in such trim as to produce alternate fruit and bearing wood. Those canes which had fruit are pruned back to one eye, to make bearing wood for the next year, and alternate canes to two eyes, to bear the present. It requires skill and experience to manage vines on trellises, in order to get large crops without weakening the plant.

There are many different modes of training vines on stakes, according to the soil, climate, and skill. They may be trained without stakes, on one or more, in spiral or pyramidal form, &c.; but the most common and simple manner is the spur and bow system. The second year they are cut back to two buds, of which two canes are obtained. The third year, one of these is cut back to a spur of two eyes, the other to a bow of six eyes; the first to form wood for the next year, and the other to bear fruit. The fourth year, the bearing cane, or bow, is cut back to two eyes; the canes on the spur one, which is the lowest, to two; and the other to six or eight eyes. The fifth year, and thereafter, there will be two shanks, each with a spur and bow, changing alternately to spurs and bows. The length of the bow must correspond with the age, strength, and condition of the vine. All the wood on the young bearing shoots must be pinched off, after it has grown two leaves above the fruit. Water-shoots, and those which are not wanted for either spurs or bows, are taken off by summer pruning. In bending and management of the bow lies the art to raise large, fine clusters of superior qualities, without straining the bearing capacities of the vine. Bows and fruit spurs must always be bent, in order to concentrate the sap in the fruit buds and check the formation of wood. For this reason, also, they must be cut loose from trellises or stakes in the fall, and, after pruning, left hanging down on the ground during winter. In the spring, after the vines and bows have been tied up, and the ground is dry and settled, all the dew-roots, or small fibres near the surface, are cut off; a heavy-pronged hoe is used for the purpose, to remove the ground about six inches deep from the vine, to facilitate this work; the soil is put back again afterward.

The object of this operation is to induce the vine to push its roots deep in the ground, for better nourishment, and to check its tendency to superabundant wood. By this mode of root pruning, it is easy to keep the vine in proper bounds, to render suckers and water-shoots less prolific, and greatly to improve its fruit. Stakes will last twice the time if they are taken up every fall, and put under cover during winter, or, at least, piled up, bottom point uppermost. About a fortnight after root pruning, the soil needs stirring; if this can be done with horse and plow, it will be an easy task, otherwise it must be spaded or hoed; the garden fork will be the best instrument. This is a good time, also, to manure with lime, ashes, or bone-dust, and mix them with the ground.

After the second summer pruning—that is, when the fruit is nearly full grown—another plowing or digging of the ground is necessary, in order to keep the weeds down and the soil open and free to the action of the atmosphere. When the fruit begins to color and ripen, it is of great importance for its perfection, as well as to strengthen and mature the new wood, to top the young shoots which are left to grow as bearing wood for the next year, and thus to check their growth. During the summer, indications of disease often appear on the vines, which may occur from different causes; they are perceptible in the color of the leaves when they assume a dull, pale, yellow color, commonly after several rainy days, or sudden changes of the weather from very hot to cold, chilly, and cloudy days. When the leaves having this

appearance begin to shrivel up, insects will be found the cause—the aphis—which will generally appear after very hot days and thunder-storms, the sun coming down hot on them, while dripping with water, and no motion of the air. In both cases their organism and functions are irritated and made sick. The best preventive is a high, free, and open position; the cure, the application of plaster or sulphur. Therefore, plaster should always be kept in readiness. In either case, a good dusting of it all over the vines early in the morning while the dew is on, and this several times repeated, will excite the action of the leaf again and destroy the insects. Sulphur, as it is more expensive, may be reserved for other and worse diseases—the rot or mold on the fruit. If this makes its appearance, a good dusting of it will stop the disease. But, again, a high, free, open position, and a gravelly, porous soil, are the best preventions.

Protection of tender plants during the winter.—With very little trouble, tender plants may be protected from the destruction of a severely cold winter, and foreign varieties cultivated with success, even in a northern climate. All that is necessary is to lay the vines flat on the ground late in the fall. With the garden fork the soil is taken up about nine inches deep on one side of the vine, which will prevent it from breaking, and brings the vine so much better down and even on the ground; after this object is gained, the earth is replaced and a few forks full added; the canes are taken together, laid down, and covered at some convenient place with earth or stones to keep them in such a position. This simple operation will preserve them in a sound, healthy condition, and increase their fruitfulness. In the northern part of Germany, where corn cannot be grown on account of the coolness of the summer, the highest cultivated varieties of grape-vines are produced with good success; the winters there are as cold as in the northern parts of our country, and would destroy the plants as well as here if they were not thus protected. As a proof that foreign grape-vines can be cultivated in this country, even as far north as Boston, it may be stated that Mr. Harding, of that city, has cultivated and fruited the "Sweet-Water" in open ground for many years with great success; and, in fact, this vine looks as healthy and thrifty, and bears as regular and large crops as could be expected from the best treatment under glass. So has Mr. Syfferman, in Malden, north of Boston, several highly improved varieties from the Rhine growing in the open land of his garden; such as the Trollinger, Gutedel, Elbing, Traminer, and white and black Burgundy, and has obtained from the first kind, for five years, a regular and full crop annually. Of course, these would be destroyed if left unprotected, or, at least, so much injured as to render them subject to diseases and insects. Protection through the winter and good culture have proved that foreign grapes can be successfully cultivated in our country. Nothing pays better than a little extra care and good management of the vine.

German, French, and Hungarian methods compared to ours, with regard to their adoption.—Although these methods are based on one and the same fundamental principle, there are some considerable variations in the culture and training of the vine, according to old habits, soil, and climate. With the introduction of grape culture into this

country by the Germans, their system has likewise been adopted. On the Ohio, Missouri, and Hudson rivers, south, east, and west, where-ever the vine ornaments the land, it has been planted, with very few exceptions, by Germans; they have succeeded well by their modes of culture; modern improvements in the propagation and culture have been adopted, step by step; so that if we bestow the same care on it as in the other country, there will not be much difference from the general German system.

The prevailing French mode is, in general, either the trellis, or bow and spur system, practised, perhaps, a little more artfully and exactly to the point. But the Hungarians have a different way of pruning and training; they do not allow wood to grow for shanks and branch canes, but cut all off, low on the ground, every year; the stock forms a head, from which one or two shoots are allowed to grow and bear; in the fall they are cut off, and the stock covered with coarse manure, or litter. One other mode is, to raise alternate shoots, one to bear, the other to form wood for next year; the bearing canes are bent down, and a few eyes covered with earth, to strike roots near the top, where three or four are left to form a new plant, and bear at the same time. Canes thus treated bear very heavy crops, as they have two sets of roots for their support. I am not aware whether this mode has yet been introduced in our country, but it would be well to try it. The vines must be trained to it while young; the first growth will have to be pruned back to one eye to form the stock, and afterwards, every fall, back to the socket of this bud; all other shoots, except one or two, are broken out.

THE STATE OF THE GRAPE---WHEN AND HOW IT SHOULD BE GATHERED, AND APPARATUS FOR WINE-MAKING.

Signs when the grape is ripe, and may be gathered.—There are certain signs when the fruit has attained its perfection: the green stem of the cluster changes to a brown, woody color; the bunches begin to hang down heavily on the canes, the berries getting soft; a thin and transparent skin; the juice vinous, agreeable, sweet, thick, and adhesive; the seeds free of the pulp, and dry.

Disadvantage when the fruit is unripe, or dead-ripe.—In the first case, the formation of sugar is not developed, hence the predominance of acids in the wine, and its inferiority. In the second case, the necessary vinous acids are last to neutralize, and give character to a syrup-like wine, not to take in account the great loss in quantity.

Gathering, sorting, and transporting the fruit to the press.—When it is determined to gather the vintage, sufficient help should be provided in order that enough may be collected every day to fill a large fermenting vat in the evening or night; sharp pruning knives or scissors should be used, to prevent jerking and dropping the berries. When a bunch is cut off it has to be examined, and all dry, green, and rotten berries picked out and thrown away, while unripe and other imper-

fect berries or bunches should either be allowed to remain on the vines, or sorted out and gathered by themselves. The bunches should be handled carefully, so as not to bruise them. Clean wooden pails are best to use, each hand being provided with one; and for transporting the grapes to the mill or press, a wooden tub, constructed in a cylinder form, but flat on two sides and a little wider on the top, with straps, so it can be carried on the back, and holding from two to three bushels, will be found very serviceable; or, if the distance to the press is considerable, a wagon with large tubs on it will be required, the tubs to have wooden covers. Clear, dry weather must be chosen for gathering the grapes, and the operations must not be begun in the morning till they are perfectly dry.

The quality of the wine will be much improved if the grapes are visited by a slight frost before they are cut off; particular pains must be taken to have everything used in gathering clean to the utmost; and no lunching or eating should be allowed near the vessels where the grapes are kept, as the smallest quantity of bread or any eatable coming in contact with the grapes or juice will produce disastrous effect on the wine.

The wine-press and its apparatus.—In the vineyard culture, a good wine-press is most important. It is composed of a platform, frame, and screws. The best seasoned white-oak should be used; the platform to be of four inches thickness, the frame of sufficient strength, and the screws either of wood or iron, but strong enough to answer the purpose. A large press with two screws is always preferable to a small one, as it performs the work more thoroughly, and a greater part or the whole of the vintage can be pressed at once, which is a consideration in making wine according to the principle that the quicker the operation of gathering, pressing, and filling into the casks, the better its quality. The press should be near, or above the cellar, with all its apparatus, fermenting vats, &c., inclosed in a building erected chiefly for that purpose; and nothing else should be kept in the press-house. It should be substantially built, have good ventilation, and be capable of maintaining an even temperature, as this is very important while the must is in its fermenting process. Next to the press, an apparatus is required to mash the berries. This may consist either of a grape-mill, with two iron rollers or cylinders, a deep, strong-built tub, in which they are crushed by a beater, or a pair of boots with double soles and without heels, long tops, and unblackened, to tread the berries on the press, or in a box with holes in the bottom to let the juice through, having hinges, hooks, and staples on one side to open for the mash or trester to be let out. There are cases, also, when, it being desirable to exclude the stems, a strong wire sieve, with about an inch-wide masher, will be necessary.

The fermenting apparatus and casks.—The size of the fermenting vats should precisely correspond with the dimensions of the vineyard, in order to get the whole vintage into one or two. As the average yield from an acre of well-cultivated vineyard may be set down at four hundred gallons, the vats should be one fifth larger, for the expansion of the must while in a fermenting state; by calculation and comparison it will be ascertained how large they should be. Well-seasoned, two-

inch white oak planks should be chosen for the construction, and hoops one third of an inch thick, of good soft iron, connected by a screw, that they may be loosened or restricted according to the swelling of the wood. The proportion should be as three to four, or one-fourth higher than wide. When the vat is thus far constructed and set up, a false bottom is made, from well-seasoned white pine boards, and holes bored all over, for the purpose of putting it on the husks, to prevent their rising and coming in contact with the air. Its position must be regulated by two or three sticks, of two inches square, let through by means of a dozen holes in each, with one wooden pin underneath and one above the bottom; the sticks or joists to rest against the cover of the vat. It may be placed two feet or more under the surface of the must, and the pomace kept down that much.

A strong cover must likewise be constructed as a head for the vat. It is fastened on by means of grooves, like the heads in casks. This cover should fit well, so that all external air may be excluded, and screwed and pinned together in one piece. When putting it in, the screw on the upper hoop is loosened, to make it easy, and when the head is accommodated in the grooves the hoop is again screwed tight. To regulate the formation of carbonic acid gases and their outlet, and to prevent an explosion of the vat, a two-inch hole is bored through the head-piece, into which is fitted a tube-bung—a cylinder made of white tin. It may be constructed like a yoke-bow, rising with the shank fixed in the hole about eighteen inches, and the other end coming down within six inches of the cover, and terminating in a vessel of water.

Another hole, three inches wide, is made in the head, into which a bung is fitted, with a two-inch hole bored through; on the top of the bung is nailed a piece of sole leather on one side, on which a two-pound lead is placed, to hold it firmly and exclude the air; the leather at the same time acting as a safety-valve, in case the gas should develop very rapidly. As the vat should never be filled to the top, but about eighteen inches space left between the head and the must, another small hole is made through one of the staves, to show when the vat is filled to that point, which is then closed by a wooden pin or plug. Again, another hole is required, about the middle of the vat, to admit a small faucet, by which must may be let out to be examined. Finally, a hole is made close at the bottom, for a large faucet, to let off the young wine when it has finished its fermenting process.

There is still a better apparatus for examining the must while in its different stages of fermentation, and to indicate the quantity in the vat. It is a glass tube, or cylinder, about an inch thick, inserted near the bottom of the vat and forming a right angle, the other end running close along the vat to the top, and fastened to it by a staple; the capacity of the vat is indicated by marks on this tube, showing precisely how many gallons it contains, with the state of fermentation, and the changes of color in the must. When the color of the wine is a great object, this is one of the best contrivances to determine when the young wine should be drawn from the husks.

For a small vintage, a large cask or pipe may be fixed up to answer the same purpose; the head with the faucet hole is taken out, a false

bottom fitted in, a hole for a faucet bored near the bottom, and the other fixtures added.

The casks for receiving the young wine from the vats should be large, holding from one to two thousand gallons each, or the whole vintage; they should be made from the very best seasoned white oak, having strong iron hoops, with screws attached, a common two-inch bung-hole, and in one head a door, eighteen by twenty-four inches wide. The door is fastened on hinges, opening inside, and has two stout bolts and a cross-bar of oak outside, with two holes, through which the bolts are passed when the door is closed, being further fastened by two notches with wings. Another small hole is made in the middle of the head, in which a wooden faucet is inserted, for drawing out samples. The door is intended to admit a man, for the purpose of washing and cleaning the cask.

As such large casks cannot be removed from the cellar, particular care is requisite to keep them clean and sweet, but they will last any length of time if made of good material. A cask for keeping wine should never be used for other purposes. As soon as it is empty it must be washed clean, inside and out, well sulphured, and the bung driven in again. It should be kept in an airy, shady place till wanted for use; the press-house would be the most suitable.

A couple of pails are necessary for exclusive use in the cellar; they are generally made of oak, and in the form of a vase, having a narrow neck, but widening again at the top, which is made of copper or iron, the hoops and handle being composed of the same metal, and should hold exactly five gallons, being gauged to show by a mark each single gallon.

Funnels of different sizes are also wanted, the largest to be made of oak wood, holding about six gallons, with a copper or iron tube on the bottom, to go into the bung-hole of the casks, and two staves projecting three inches at the bottom, for two feet, to make it stand firm, a little declining towards the tube-hole.

Lastly, for drawing wine in or out of the casks a good siphon is required. This may be made of tin or lead pipe, but, for convenience, should have a small faucet soldered on, as a mouth-piece. All these articles should be kept as clean as everything pertaining to the cellar and presses, and never used for any other purpose.

The cellar, how it should be constructed.—A good, well-ventilated and drained cellar is absolutely demanded for wine making. To secure an even temperature, it must be deep, and arched over with stone or brick, the stone-work smoothed off with plaster, and whitewashed; the floor either of flag-stones or brick; and to prevent the hot summer air getting in, and likewise the cold in winter, a separate entry for the steps is required, with a door at the top and another below. Several air-channels or flues must be arranged from the arch to a couple of feet above the ground outside. The arch is covered with from four to six feet of earth. And this is now the most practical spot to build a house large enough to contain the press, a fermenting room, with conveniences for heating, connection by conduits with the cellar, and perhaps a separate room for distillery apparatus.

WINE-MAKING.

Making white wine.—To make a first class white wine, only white grapes are used; they are mashed in the apparatus, being fixed on the top of the fermenting vat, but not allowing the husks to fall into the vat, which, after being mashed, are put on the press, and when the whole mass is thus prepared, they are pressed out, and the juice, or must, put in the vat. As there are no husks in the vat, the false bottom is not required. The head, or cover, is now put on, and the temperature of the must ascertained by the thermometer. If it is lower than 50°, some must is taken out and heated, to warm up the whole mass till it comes up to 60°, which is the point it should be brought to when fermentation takes a proper course. This temperature must be maintained as evenly as possible, and therefore a proper room, as already described, with a stove or fire-place in it, will be the most serviceable. After the temperature of the must is regulated, the bung with the safety-valve and the tube are fixed on, and a small vessel with water is placed under the other end of the tube, or cylinder, so that it will reach into the water about three inches. The whole work of mashing, pressing, regulating the temperature, and closing up the vat, must be performed with the greatest possible speed, as the juice begins to ferment as soon as it is extracted from the berries, and by coming in contact with the atmosphere, the most essential part of the wine, its chief strength, the alcohol, escapes. In proportion as the grape contains sugar, the fermentation of the must will proceed; hence the fermentation of the must from highly improved grapes of best qualities, containing much sugar, and a vintage favored with a hot, dry summer, will take twice as much time as poor and watery juice. By fermentation, the sugar of the grape-juice is converted into alcohol, which, amalgamated with the other contents of the grape-juice, forms the wine, at once fiery, aromatic, and pleasant in every respect. The dissolution of the greater part of the sugar, and the union with the acids gluten, tannin, &c., will have been performed when the must begins to get a clear color, an aromatic, vinous taste, and quiet; it is then time to draw it from the fermenting vat into the casks, in which it will slowly finish its fermenting process. Rich must will ferment in from five to eight days in the vat, while that of inferior quality gets through in two or three days. It is very important to have large casks in which to keep the wine, as thus its properties and character are much better preserved.

When the casks have been filled, a similar tube is fixed, as on the fermenting vat, with one end in the bung-hole and the other in a small vessel of water.

Making schiller wine.—This name signifies a particular color of the wine, varying from one hue to another, and to be called neither white, yellow, nor red. Grapes of all colors are used in making this wine; they are mashed by putting the mill on the top of the vat, and the husks put in it, and fermented together with the must. When they are all mashed, or one vat is filled, the false or fermenting bottom is set in, to keep the husks under the must, and the head and other fix-

tures put on. The fermenting of schiller wine takes a longer time and is more stormy than white or claret wines; but this is stronger, more fiery, and aromatic, than either.

The same temperature is required as for other kinds. Much care, however, must be taken to watch its culminating point, when the carbonic acid gas escapes furiously, the water begins to roar in the little tub, and the safety valve works like a hammer, that nothing may interfere with the action and function of those agents, on which depends, in this critical period, the safety of the whole contents of the vat. The agitation may be observed still better in the glass tube connected with the vat; but after a short time, only a few hours, the must will calm, the fermentation proceed more quietly, and, in two or three days, begin to get clear and vinous, which is the time for drawing the young wine into the casks, there to complete its fermentation. The husks are pressed and the juice obtained added to the rest. As soon as one cask is filled, the tube is fixed into the bung-hole, and a small vessel of water put under the other end, to keep the air from contact with the young wine. The ventilation of the cellar is so regulated as to get an even temperature of about 50°.

Making red wine, or claret.—The blue and Traminer-colored varieties are used for this purpose; after the whole vintage, white, Traminer, and blue, or black, is made into claret. The color of the juice has to be examined, if it be not of the desired dark-red, some coloring matter must be used. There are several harmless substitutes, such as well-ripened elder berries, the berries of the hawthorn, &c. Whatever kind of berries may be used, they should, in all cases, be perfectly ripe; still better if they have been picked some time before they are wanted, and dried in the sun. The quantity of these must be ascertained by taking a sample of the must and adding berry juice till the desired color is obtained; but, as the red or claret wines become lighter by age, the color should at first be a few shades darker.

Claret wine takes more time to finish its fermenting process than any other. It is perfected when the color becomes clear, and the taste changed from sweet to strong vinous. According to the state of the weather and the season, which influence the quality of the grape, the fermentation will proceed, but the ordinary period requisite to complete it is from eight to ten days. When finally fit to draw into the casks, the management is the same as with other varieties; the husks are put under the press, and the extracted juice into the casks and mixed with the juice first drawn. The sediment or lees, from either variety, is saved in a cask for further use.

The husks, which still contain a considerable amount of wine-making properties, after the juice has been extracted from them by the press, are broken up fine, put into the fermenting vat, and water, in equal proportion to its bulk, is added—to each ten gallons of water one gallon of lees—to strengthen and facilitate its fermentation. A light but pleasant wine is obtained in this way, which is fit to drink the next summer, and will be found, in hot weather, a very agreeable cooling drink. All the seeds should be saved, well dried, and hung up in bags in an airy, dry place.

TREATMENT OF THE YOUNG WINE.

The second fermentation.—The young wine, after it has been brought into the cellar, will go through another course of fermentation, and will be more or less agitated for a certain time. The casks have to be filled occasionally, and kept full to the bung; the dissolution of the sugar and of the different constituents of the wine will proceed slowly, and finally cease altogether; the undissolved matter settles on the bottom of the cask, and is called lees. When the wine gets to such a state, quiet and clean, it is time to draw it off into another cask. The casks, before using them, must be well cleaned and sulphured, which is done by dissolving sulphur in an iron pan over a fire, cutting strips of cotton cloth or linen two inches wide and nine long, and soaking them in the sulphur; then a piece of wire about a foot long is fastened to the bung, and the other end bent to a hook, on which is hung an ignited strip of the sulphured cotton, and introduced into the cask, the bung driven in, the cask rolled to and fro, and finally the sulphuric acid gas, which has not penetrated into the wood, let out by loosening the bung.

A siphon, reaching about two thirds to the bottom of the cask, is used for drawing. If the empty cask can be placed near enough, so that the other end of the siphon reaches to its bung-hole, it is so much better, as there is less escape of the gaseous and flavoring ingredients of the wine. The rest of the wine which the siphon does not draw is drawn off by a faucet, about six inches above the bottom. When a cask is thus filled to the bung-hole, the bung is driven in tight.

In order to preserve the fine, clear condition of the wine, all jerking and other rough treatment of the casks must be avoided. The lees from the emptied casks are collected into a cask by itself.

White wines will have attained the proper condition for drawing in a couple of months, wine of inferior quality still sooner, and should be drawn immediately after showing a clear, bright color, as the sediment injures its taste and character.

Schiller wine, according to its quality and intended use, may remain some time on the lees, especially if it is designed for preserving to an old age; but in most instances it will improve by drawing as soon as it is clear.

Claret wine, however, should remain from five to six months in the first cask and lees. When fermentation is no longer perceptible, the cask is filled, the bung driven in, and it is left undisturbed till the drawing is finished. The exact period is a matter of fashion, according to the taste and habit predominating in the country where it is sold. By letting it stand on the lees for several months it obtains more of those peculiar principles, astringency, &c., preferred in a good claret.

No wine should be drawn, and no good wine-cooper will open a cask in cloudy or sulky weather, as the wine, coming in contact with such an atmosphere, gets turbid and excited; therefore cool and bright days must be chosen for that purpose. All articles used in the draw

ing, no matter how clean they may be kept, should be previously rinsed with wine.

Remedies for flat and turbid wines.—There are many instances when the wine loses its character, either turning flat, or getting excited and turbid, when it will be necessary to attend at once to its restoration by applying proper remedies, and prevent it from total destruction. By acting according to the principles set down here, such cases can occur only by accident; but, to avoid the calamity, constant care is required. The causes may be different, but generally it will be found that neglect, merely, or perhaps ignorance of proper management, created the trouble.

When wine becomes flat, it wants stimulating. This may be done by various means. The liquid from two pounds of raisins, cut fine, and soaked a few days in a gallon of good rectified alcohol, then pressed and strained, is mixed with a couple of gallons of the flat wine, heated to near boiling, and all put into the cask again. After it has been well stirred, the bung is replaced and left undisturbed for at least two months, when it may be drawn into another cask, previously well-sulphured. Every thirty gallons will require a gallon of alcohol and two pounds of raisins.

Another good remedy is, from each thirty gallons of flat wine two gallons are taken out, two pounds of well-dried grape-seed added, and brought over fire; while it is heating the seeds are stirred and rubbed with a beater, and after a while the liquid is strained and put hot into the cask again, which is bunged up immediately. Practical knowledge and experience are necessary to manage such wines; but the cause of the trouble may easily be prevented by adhering to the general principles of wine-making.

If the cask produced the flatness, the wine must be drawn first into another, before anything is done with it. When the wine becomes excited, turbid, and ferments again, which may occur often in poor cellars, if the weather should change from cold to warm, or if the casks have been opened in close, sulky, and cloudy weather, the difficulty will be found most likely in the cellar. Wine cannot be expected to keep and mature well in a poor cellar, which, perhaps, is also used for other purposes.

Sulphur is a good remedy. An empty, clean cask is provided, two gallons of the infected wine put in, a strip of sulphured cotton ignited, the bung driven in, and the cask rolled. After a while, two gallons more of wine are put in, sulphured, and rolled again, according to the quantity to be cured; eight or ten gallons may be impregnated with sulphur, or even more; and finally restored to its stand, and well-stirred, with the bung out.

Further treatment of the wine, and its fining.—After the wine has been drawn once, there is still more or less undissolved matter in it, which will soon settle to the bottom of the cask and therefore render necessary another drawing. This must be done, generally, three or four times before the wine gets clear, well-fined, and fit for the market. The proper time for drawing will be at intervals of from three to five months; but experience and judgment alone can point out the exact period. If it is desired to sell the wine before it has attained its finish,

it must be fined. This is done by taking out of the cask from four to five gallons, and adding to each thirty gallons the whites of ten eggs; these are beaten to foam with the wine, finally put into the cask, well stirred, and the cask bunged up.

Or powdered gum arabic may be used, in the proportion of one ounce to fifty gallons of wine, well stirred with the whole contents. Both articles are perfectly harmless to the character of the wine, and entirely answer the purpose. In the course of from four to six days the wine will be in the desired condition to draw and bottle for market. It will keep best and improve more in the casks; but there are several instances when, after it has been drawn, and the casks filled, portions remain, for which no casks small enough can be provided; it is better to draw such portions at once into bottles. Simple as the bottling seems to be, yet there are many things to be observed, in order to keep the wine well and prevent it from becoming flat and turbid. The first and chief requirements are clean, sweet bottles, and new, fresh corks; it must be a rule strictly adhered to, that as soon as a bottle is emptied it is to be rinsed out well with water and placed in the open air, on a shelf or frame erected for the purpose; before using, it is rinsed out once more, and then filled within two inches of the mouth. The cork, which should fit exactly, is dipped into wine, and driven well in. The bottles should always be placed in a horizontal position, so that the corks cannot get dry and admit air, which is generally the reason why the wine gets flat. They keep best if put in dry sand, one above the other. As further protection, the corks may be waxed.

USE OF THE HUSKS, LEES, AND SEEDS.

Use of the husks.—These may be differently used; a pleasant wine can be made of them, in the way already described, but a real good marketable wine is obtained by adding sugar in proportion to the vinous principles, found out by proper instruments, by which all wines have to be brought up to a certain standard point, most favorable to their development. But, as a description of this modern art of wine-making would require more room than has been allowed, it may only be mentioned that a vintage can be increased from a hundred to two hundred per cent. without the least detriment to its quality.

If the husks are not wanted for this purpose, a good vinegar may be obtained from them. As soon as they come from the press they are broken up fine, and put into a vinegar vat, twice their bulk of rain-water added, with two gallons of lees and a quart of beer-yeast to each barrel. The vat is set in a warm room, *but not in a fermenting room, cellar, or anywhere near wine*, and allowed to stand till the vinegar is formed, which is then drawn into barrels, the husks being brought to the compost heap, or directly to the vineyard.

Use of the lees.—The lees contain considerable undissolved sugar and other vinous substances, which, by distilling, make a highly flavored brandy. The quantity may be increased without affecting its good quality by adding to each barrel of lees half a barrel of well-rectified alcohol; that from potatoes is the best. Let it stand a couple of weeks, turning the cask once or twice a day, and finally it will be

fit for the still. The remainder in the still, too weak for brandy, makes a good vinegar. Lees are likewise a good stimulant for flat, insipid wine, and a portion should always be kept on hand to be thus applied.

Use of the seeds.—Grape seeds are very valuable for fining and strengthening the wine; they may be used either in the manner mentioned, or a few handsful thrown into the cask just as they are. They must be well dried, and kept hung up in an airy place.

DRS. GALL AND PETIOL'S METHOD OF WINE-MAKING, ACCORDING TO THE MODERN PRINCIPLES ADOPTED IN GERMANY AND FRANCE.

In consequence of many failures in the ripening of the grapes, and diseases spreading rapidly over the continent, more or less destroying the crops of whole districts, grape culturists and chemists began to look for remedies and substitutes for those principles in which the vintages are deficient.

Much has been said against this method, and much suggested to neutralize predominating acids without resort to sugar and water, but all experiments have thus far failed, either the wine would get flat at once, or be unfit for use on account of its harshness. More than fifty years ago, Chaptal, Cadet de Vaux, and other eminent chemists, suggested that poor wines might be improved by adding sugar; later, Claudot-Dumont urged his countrymen to abstain from the bad practice of sweating and mixing their poor wines, and recommended sugar as the best agent to improve them. But neither of these chemists were able to point out in what proportion sugar should be used to obtain the desired result. This problem has finally been solved by Drs. Gall and Petiol, and approved by such men as Thénard, Döbereiner, Von Babo, Bronner, and others.

Drs. Gall and Petiol both discovered, after many analytical experiments and researches, that the surplus acids in the grape-juice can be turned to good account, by bringing its other ingredients (sugar and water) to a proper proportion. Every kind of grape-juice is nothing but clear water, in which are dissolved from six to thirty per cent. of sugar, two to four per cent. of free acids, and from three to five per cent. of other matter, or the essence of wine-making principles. Sugar converts itself into alcohol by fermenting, and two per cent. of sugar will produce, in the average, one per cent. of alcohol; the free acids, if they are in proportion to the other principles, give the wine its agreeable vinous character, its flavor, &c.; the last properties contain the principles necessary for fermenting, fining, and keeping. Dr. Gall has further proved the fact that these different acids in the grape do not require particular notice; it is sufficient to find out the whole sum, and then treat them alike. In order to ascertain what per centage of sugar and acids the must, or grape-juice, contains, two different instruments are required, a "must scale" and an "acidimeter;" for the first purpose *Oechsle's must scale* is generally used, and *Otto's acidimeter* for the second; on both are the following calculations based, illustrative of this method. None of these instruments have been yet

introduced into our country, but it may be presumed that, when a demand for them shall be manifested, some of the leading druggists will respond, and import them. They may, however, be procured at any time direct from the manufacturers, Dr. L. C. Marquart, of Bonn, on the Rhine, or J. Diehn, Frankfort-on-the-Main.

Experiments continued for eight years have proved that, in favorable seasons, grape-juice contains, in the average, in 1,000 pounds:

Sugar	240 pounds
Free acids	6 pounds
Water	754 pounds
	1,000

Which proportion may be set down as a normal; therefore, to obtain good wine from a vintage of inferior quality, these proportions must be secured by adding sugar and water. It will be seen that the contents of the acids are the indicating point as to what quantities of sugar and water would be required to bring the wine to such a normal state; further, as has been the case generally, the less sugar the more acids. The per cent. of acid in the grape-juice is the basis on which a calculation must be founded.

All practical grape-growers and wine-makers in Germany and France admit that a wine containing the proportion of sugar, acids, and water above-described, is in every respect preferable to heavier or lighter wines. It has lately been called a "normal wine," and will serve here as well as a standard.

When a must contains, instead of twenty-four per cent., only fifteen per cent., or instead of two hundred and forty pounds, only one hundred and fifty pounds of sugar, but, instead of only six per cent. or pounds, nine per cent. of acids in one thousand pounds, the question arises, how much sugar and water will have to be added, to bring such a must to the proportion of a normal wine? To solve it, we calculate thus: if, in six pounds of acid, in a normal wine, two hundred and forty pounds of sugar appear, how much sugar is wanted for nine pounds of acids? Answer: three hundred and sixty pounds. And again: If, in six pounds of acids, in a normal wine, seven hundred and fifty-four pounds of water appear, how much water is required for nine pounds of acids? Answer: one thousand one hundred and thirty-one pounds. As, therefore, the must which we intend to improve by neutralizing its acids should contain 360 pounds of sugar, 9 pounds of acids, and 1,131 pounds of water, but contains already 150 pounds of sugar, 9 pounds of acids, and 841 pounds of water, remain to be added 210 pounds of sugar, 0 pounds of acids, and 290 pounds of water.

By ameliorating a quantity of 1,000 pounds must
by 210 pounds sugar
and 290 pounds water,

we obtain 1,500 pounds of must, consisting of the same properties as the normal must, which makes a first-class wine. The increase of the quantity is five hundred pounds, or two hundred

and fifteen quarts, which, after deducting the outlay for sugar, two hundred and ten pounds, at twelve and a half cents per pound, amounts to twenty-six dollars and twenty-five cents, and, allowing fifty cents per quart, leaves a clear profit of eighty-one dollars and twenty-five cents.

Another illustration, which probably comes near the qualities of northern wild native grapes—already largely manufactured into wine, but, for want of knowledge, seldom accepted in market—may be thus calculated: Such grape-juice, or must, contains twelve per cent., or one hundred and twenty pounds of sugar, and fifteen per cent., or pounds of acids. One thousand pounds of such must will consist, then, of one hundred and twenty pounds of sugar, fifteen pounds of acids, and eight hundred and sixty-five pounds of water. In order to neutralize these acids, and make them proportionate, corresponding with wine of a good character and normal state, it will require to 15 pounds of acids, 600 pounds of sugar and 1,885 pounds of water; as the must contains 15 pounds of acids, 120 pounds of sugar, and 865 pounds of water, have to be added 0 pounds of acids, 480 pounds of sugar, and 1,020 pounds of water.

Such improved must will, therefore, consist of—

15	pounds of acids,
600	pounds of sugar,
1,885	pounds of water,
2,500	pounds.

Deducting one thousand pounds of must, which furnished the wine-making principles, acids, &c., gives a surplus of fifteen hundred pounds, or six hundred and forty-five quarts of must in a normal state. Value of six hundred and forty-five quarts, at fifty cents per quart, three hundred and twenty-two dollars and fifty cents. Cost of four hundred and eighty pounds of sugar, at twelve and a half cents per pound, sixty dollars. Net profit, two hundred and sixty-two dollars and fifty cents.

It will be seen that such wine is produced at the small expense of nine and a quarter cents per quart, omitting the one thousand pounds, or four hundred and thirty quarts, which furnished the wine-making principles. But a true estimate of the cost of such a wine from the wild native grapes when they have to be bought must be calculated thus:

3,000 pounds of grapes, at $3\frac{1}{2}$ cents per pound	$105
480 pounds of sugar, at $12\frac{1}{2}$ cents per pound	60
	165

And as one hundred and sixty-five dollars make two thousand five hundred pounds of must, or one thousand seventy-five quarts, the actual expense is fifteen and one third cents per quart; allowing interest on capital invested for apparatus, casks, shrinkage, and labor, the whole expense will not average twenty cents per quart.

An immense field of profitable employment presents itself to industrious men. In a favorable season a man will gather five bushels of wild grapes in a day, from which he obtains at least eighty quarts of natural wine, while if ameliorated according to Drs. Gall and Petiol, he will get one hundred and twenty quarts of good normal wine.

It is further proved that such wines made according to these principles mature at least in half the time required by natural wine, and keep better; consequently, permitting a quicker return of invested capital, a better article for speculation, safe transport to distant markets, &c. Thus, too, a good wine can be made of an inferior vintage, grown in an unfavorable season, and the quantity of a rich vintage increased to two hundred per cent., without the least detriment to its quality. It is very important that this method should be introduced into our country; it will not only encourage people to more activity in this lucrative branch of industry, but will furnish us with a wholesome and pleasant beverage; insuring as a pure, cheap article, a large consumption and a ready sale.

Grapes properly cultivated in vineyards or gardens, and in favorable climates and localities, will generally contain sufficient sugar and no surplus of acids; so it may appear that there is no need to practice this method. But Drs. Gall and others found by analyzing the husks or pomace, after the juice had been extracted by means of powerful presses, that these not only still contained a considerable amount of juice, but also a great amount of extracts or wine-making principles, in many cases sufficient for three times the bulk of the juice previously obtained. This fact suggested the question: as there are so many of these valuable properties left, and only sugar and water exhausted, why cannot these principles be substituted till the other are completely used up? It was found that it could be easily done!

The secret of making wine from water was thus solved, and an all-important principle for wine-making established. By further experiments these speculations not only proved to be correct, but it was in most cases impossible to judge which was natural wine, or which the product of this new method; indeed, the preference is generally given to the latter. While natural wine is so very different, according to circumstances which prevailed in its growth, such "Gallized" wine is always in perfect harmony, because its contents are not the results of chance, but the close following of the process of Nature.

The practice of this method is quite simple; for instance, let the vintage be of an average good quality, the must containing twenty-four per cent. of sugar and six per cent. of acid, and the quantity one thousand pounds. The grapes are mashed in the usual way, but not pressed; the juice, if it be white wine, drawn off into casks to ferment; if claret or red wine, it is fermented on the husks, as described in a former paragraph, and then drawn off into casks. Before this is done, however, two hundred and forty pounds of sugar are dissolved in seven hundred and fifty-four pounds of water, and as soon as the grape-juice is drawn off, this solution is put on the husks in the fermenting vat. It is absolutely necessary to have sugar-water prepared and ready for an infusion before the wine is drawn from the fermenting vat, and put immediately on the pomace as soon as the wine is off, to prevent their

coming in contact with the air, getting dry, moldy, and spoiled. It is practicable to draw off this infusion once and put it on the husks again in order that their fatty substances may be better dissolved; but this operation has to be performed without delay, as fermentation commences immediately, and must not be interrupted. The water used for that purpose should be soft rain or cistern water. A large iron or copper kettle is put over a fire and heated, in which the sugar is thoroughly dissolved, and then the whole brought to a temperature of 70° and poured over the husks in the vat.

The mode of fermenting, temperature, and the entire operation, is the same as before described. To obtain a certain color, it may be necessary to let this second wine remain longer on the husks and in the vat. The proper period for drawing will be best found out by often examining samples till the desired result is obtained. When this is the case, the young wine is drawn off and filled into casks.

Again, two hundred and forty pounds of sugar are dissolved in seven hundred and fifty-four pounds of water put on the husks and managed as before stated. Should this second wine, after it has fermented and been drawn off from the lees, contain less than five per cent. of acid, it will be necessary to add two ounces of tartaric acid to each one hundred pounds, or twenty ounces to one thousand pounds of wine; the tartar is pulverized and dissolved in two quarts of heated wine, which is then put into the casks and well stirred.

After this third wine (second infusion) has fermented and been drawn off, the husks are taken out and put under the press, and the extracted juice added to the rest in the casks. This wine is treated like other wines, only left some time longer on the lees before drawing and fining. There is, from one thousand pounds, or four hundred and thirty quarts of must, an increase of two thousand pounds, or eight hundred and sixty quarts of wine, which, after charging for four hundred and eighty pounds of sugar, at twelve and a half cents per pound, will equal sixty dollars, or not quite seven cents per quart.

The must-scale and acidimeter have to be used often while such wine is in its fermenting process, and before it is drawn off from the vat, in order to examine and find out the capacity of the husks, whether they contain sufficient properties for another infusion, or only for a part. If the result of the examination of the young wine shows an undiminished amount of acids, the husks will bear another infusion of sugar-water to the same amount as before; or if there is found a deficiency of one and a half or two per cent., the quantity of sugar and water must be regulated accordingly. For instance, after the first infusion has fermented, the pomace shows a decrease of two per cent. of acids, or wine-extracts, but there is still four per cent. remaining, which, if fermented with a proportionate quantity of sugar-water, will make as good a wine as any. Therefore, to determine of what proportion the second infusion should consist, we calculate thus: If six per cent. of acids require two hundred and forty pounds of sugar, how much is wanted for four per cent.? Answer. One hundred and sixty pounds. Now, if six per cent. of acid required seven hundred and fifty-four pounds of water, how much is wanted to four per cent.? Answer.

Five hundred and two and two third pounds. There is consequently wanted for the second infusion one hundred and sixty pounds of sugar and five hundred and two and two third pounds of water.

It will sometimes be found that, after two infusions have been fermented, and two hundred per cent. obtained, the pomace still contains several per cent. of wine extract; therefore, a third infusion of sugar-water may be applied, and a still larger quantity of wine obtained. The calculation in regard to the amount of sugar and water to be used is the same. In either case, should a stronger vinous taste be desired, tartaric acid is added by degrees till the object is attained.

To facilitate these manipulations, it is necessary to construct tables, in which the proportion of weight and measure to each other are calculated. It will be found more convenient in practice to measure the must and water, instead of weighing, and as must will differ in its specific weight, according to its acids and saccharine properties, it is necessary to have a table, on which can be ascertained, according to the indication of the scales, the exact amount of each. On the table, for instance, which has been calculated and constructed to Oechsle's must-scale, when ninety-five per cent. is indicated, it will be found that the must contains 21.8 per cent. of sugar. The acids and extracts which the must contains increase its specific weight, and prevent the scale from sinking and showing the amount of sugar correctly, being deducted, and the exact amount of sugar found on it. For the acidimeter, a table is constructed, on which is found the calculation how the per cents. of acid compare with those of sugar, and how much water is required for certain per cents. of acids and sugar in weight and measure.

These tables, as they are compiled in conformity with the scales, are generally supplied with the instruments, and with directions for use.

As the sugar contains more or less water, even when it appears perfectly dry, it is necessary, after a certain quantity has been dissolved for such ameliorating purposes, to use the must-scale, find out how it compares with the intended purpose, and regulate the balance by either adding more sugar or water till the desired point on the scale is correct.

It is a matter of course that only sugar of the best quality should be used; grape sugar is the best; but as this cannot be had cheap and in large quantities, white loaf sugar must be used. Still, there is no doubt that enough of the former will be manufactured as soon as a demand is manifested.

Since the introduction of this new method of wine-making into Germany, several grape-sugar factories have been established, and are all doing well, as the demand for this article increases from year to year. Grape sugar can be produced from forty to fifty per cent. cheaper than white loaf sugar; it is, therefore, a great desideratum that this method should be adopted.

It has been suggested to keep each part of the wine by itself: as the natural wine, the first, second, and third, that a fair chance of judgment may be had; but afterward, when the result has given satisfaction, and all doubts are removed, it will be found that no reason exists why they should not be mixed at once, as the care and management

will be considerably facilitated, without interfering in the least with its quality.

But as experience and judgment are required to put this method in practice, it will be best to begin with a small quantity.

Success will follow good management in this branch, as well as in any other of horticulture or agriculture, and more so here, as these principles correspond precisely with Nature.

ON THE PRODUCTIONS OF THE IONIAN ISLANDS AND ITALY.

BY S. B. PARSONS, OF FLUSHING, NEW YORK.

We landed opposite the little town of Samos, on the island of Cephalonia. Our ride up the mountain, from this place, was full of interest, with delightful glimpses of the coast and sea, patches of vines, with the peculiar ant-hill culture noticed first in Zante, and wild flowers and trees, many of which were new to us. Cyclamens, anemones, and iris were abundant. The *Quercus ilex*, or holly oak, growing in the plains of large size, became dwarf as we ascended, until, at the greatest altitude, it creeps like a vine upon the ground, in large rich masses, with very small leaves. Although flourishing here in the snow region, it has not proved hardy about New York, but would doubtless be so wherever the *Quercus virens*, or live oak, will grow. With its rich, glossy, holly foliage, it would be a valuable addition to our ornamental trees. That which most excited our admiration, however, was the *Ceratonia siliqua*, or carob tree. It is round headed, evergreen, with leaves placed and formed like the locust, but thick and glossy as the *Pittosporum*. It bears a pod, which is eaten by cattle, and is used largely for government horses in Malta. In Sicily, a spirit is distilled from it. It grows wild everywhere, and is said to be the same tree which furnished food to John the Baptist. A superior variety is cultivated by grafting upon the wild species. It would doubtless succeed in our extreme southern States, for we found it on high positions, and in the snow region. Some seeds for distribution will be forwarded to the Patent Office, and it will be found worthy of careful trial, combining, as it does, great beauty with the production of a useful article of food.

At one of the villages, we found the women crocheting capes and sleeves with a thread made from the fibers of the aloes. The fabric was light, glossy, and beautiful; and the fiber could readily be cultivated in our southern States.

The culture of grape and currant, on Mr. Pana's estate, is very thorough. It was pleasant to notice his frank, kind manner with his laborers, and their respectful, ready answers. He is said to be unequaled on the island for the thought and intelligence which he gives

to his estates. His gardens were full of oranges, pears, Japan medlars, grapes, and quinces, while roses were blooming everywhere.

We wished to ascend the Black mountain, to see the noble specimens of *Picea cephalonica*, which are found here only, and took mules up the almost precipitous sides, among piles of rocks and stones, with a few flowers struggling from among them, and very little vegetation, except mosses and the dwarf *Quercus ilex*. After some hard work, we reached the forest of pines, and, passing through a part of it, arrived at the government cottage, where rangers are kept to protect the wood. The sight of the trees fully repaid us. Here were superb specimens of *Picea cephalonica*, fifty or sixty feet high, growing where they had abundant room to develop, straight as an arrow and symmetrical as a pyramid, with the rich, glossy foliage peculiar to the species. Some of the specimens had trunks three feet in diameter, and covered as much ground as a large live oak in Florida. As the tree is perfectly hardy near New York, we were anxious to procure some seed, but looked in vain for cones. One was brought us by a ranger, but the seed was all worthless. We could now readily understand why it is that the French and English have been unable to procure this seed; and that the tree is still a rare one in England, notwithstanding the great rage there for all fine coniferæ. From the overhanging rocks, nearly three thousand feet high, we caught a superb view of the island and sea, as the clouds rolled away below us for a few minutes. The barren peaks loomed up, white with limestone; rich olive groves and small villages dotted the plain; and the sea, winding in among the islands, gave the coast many little coves with picturesque effect.

In Cephalonia, the sides of the mountains below the snow line are planted with vines on the steepest declivities. The whole ground is white with small pieces of limestone, and these are often a foot deep. Among them the vine is planted, and one can scarcely conceive how great must be the change, on the appearance of vegetation, from their present white barrenness to the living green of the new leaves. No soil was to be seen on the surface, where the vines had not yet been touched with the hoe. On digging down there is found a rich-looking, bright red soil, called *terra rosa*, which is sometimes used for mortar, and is evidently full of iron. In some places the vines were planted in water-courses, and much earth had been washed away from the roots. These are said to produce the best wine. It is evident from their experience in Cephalonia that the vine thrives well with plenty of stone and surface water. We noticed many fossils, and passed a fathomless lake two thousand feet above the sea. The whole road down the mountain was full of glimpses of beauty. In the valley we again met the luxuriant vegetation which this climate and soil give.

Cephalonia is not so highly cultivated as Zante, but its specialities are the same—currants, grapes, and olives. We saw no cows on the island, and but few oxen, of inferior breed, imported from Morea. There are few horses, and those of inferior character. Fish are plentiful and good. Lemons and oranges are abundant, but not exported. The blood-oranges are the best, and we could hear of no insect upon them. They have a singular mode of propagating the lemon, in order to insure the same variety. A branch, two or three feet long, is buried

in the ground, in a sloping direction, the upper end being six inches below the surface, and several inches of the lower end left out of the ground. In other words, it is a cutting reversed. That part above the ground sends up a shoot which grows with great rapidity, while the part below remains dormant or decays. Japan medlars grow here of large size, and are said to produce fine fruit. Currants are produced in large quantities, but with the exception of those of Mr. Pana, the cultivation is not equal to that of Zante.

Olives are cultivated by cuttings, and also by grafting. Twenty-five thousand barrels of oil are made annually. The harvest is from October to December, inclusive. The ripest fruit is the richest, and the best is grown on the hills. Five to forty bushels are produced by a tree, and one bushel will make two gallons of oil.

Near Lixuri is a heavy gray argillaceous soil, and all along the coast are numerous marshes, which could be easily drained and thus rendered extremely fertile.

The caper grows wild, but is never prepared for exportation. A list of about two hundred species of plants and trees found in Cephalonia was obtained, which, if desired, will be furnished to the department. Of these, *Salvia officinalis* is used for asthma, *Colutea arborescens* instead of senna leaves, (this is hardy near New York,) and *Phytolacca*, applied externally, is considered a specific in cancer, producing excessive pain and inflammation, and curing in six or eight weeks.

Orange trees, the size of full-bearing apple trees, and filled with fruit; Japan medlars, fifteen feet high; Portugal laurel, of the same height; large and beautiful specimens of *Lauristinus*, in full bloom, (and this in January;) pride of India; immense cactus and aloes; large acacias; a sort of Gleditschia, the pods of which are sold in the market; date palms, myrtle, pine, cypress, and olives, clothe the valleys and hills. The olives, unlike the Italian, were very large and spreading, and their trunks split and perforated, often to such a degree that one wondered where vitality could exist. The French cut down most of the finest trees during the rule of the first Napoleon, and after the island was delivered to the English, in 1815, the government offered a shilling bounty for each tree planted, hoping thus to encourage their growth. It was partially successful, and there are now a great number of fine trees upon the island. The only kind grown is the small variety, for oil. A large variety, used for pickles, is produced upon the adjacent island of Paxos.

Corfu has a great abundance of rich soil, but is not under good culture. The ruinous *metayer*, or contract system, prevails here, and few cultivate their own lands. They are let out on short leases, for one third or one fifth of the produce. For want of intelligent management, the olive and vine, of which three fourths of the culture consist, are very much neglected. The vine is of the poorest quality, while the olive trees are too thickly planted for ventilation, and never regularly pruned nor dug. Instead of being carefully picked, the fruits are allowed to fall, from October to April, and many are half-rotten before being pressed. Sometimes they are stored and salted, until a more convenient time for manufacture. The ripe olives make better oil, but not of such fine appearance as the unripe. The trees

blossom in April and ripen in October, when the fruit harvest begins. The soil is a very rich, stiff, tenacious clay, retentive of moisture, and interspersed with stone and rock, of limestone and silex. Arable land bears a small proportion to woodland and pasture.

Quercus aegilops is found in the mountains, and its acorn, called *balania*, is sometimes used for a dye-stuff. Figs, pomegranates, apricots, almonds, plums, peaches, and melons abound, and there is some culture of the cereals. Oranges fruit and flower together through all the year. Apricots, almonds, plums, and peaches flower in February. Peas, beans, potatoes, and cherries ripen in April. The hay harvest is in May; that of barley, oats, wheat, and flax in June. Indian corn and millet generally ripen in August, but sometimes, in bad years, not until September or October. The vintage begins the latter part of September.

The following table, obtained from the garrison librarian, will give the best idea of the temperature. It is the monthly average for ten years:

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Maximum	58½	59	64	70	79	87½	91	88	81½	77½	68½	62
Mean	47	48	51½	57	65½	72½	77½	76	70	65½	57½	49¾
Minimum	36	36	40	44	52	58½	64	63½	58½	53	44½	33
Inches of rain	7.40	5.27	3.74	1.69	0.69	0.70	0.23	1.36	3.17	5.86	7.25	5.47

In 1839, there were 17 inches fell in November.
In 1842, there were 19 inches fell in January.

There are no animals peculiar to Corfu. Pasture is scarce, and cattle are brought from Albania. Dogs are reared with great difficulty. The birds most common are hawks, owls, crows, partridges, quails, woodcock, snipe, plover, wild duck, and pigeons, the last in large quantities. Eggs are abundant, and good butter and cheese are made from goat's milk. The fuel is wood, charcoal, and *cliosto*, or refuse from the oil mills. The peasants are industrious and thrive well on their daily allowance of food, which is two pounds of coarse bread, seasoned by a few cloves of garlic, with a little weak wine. Meat is almost an unknown luxury with them, although we noticed in the market some fine turkeys and chickens, for the use of the wealthier classes. Among the peasants are several curative practices which they think specifics. They treat the pip in fowls by removing the crust on the tongue, and then making them swallow it in oil, which purges copiously. Convulsions in goats are cured by a seton thrust through the cartilage of the nose. Setons of green *hellebore* are inserted in horses for pectoral diseases. To prevent hydrophobia, a paste of *verbascum* and *cantharides* is given dogs. *Teucrium tincture* is used for intermittent fevers. Excellent honey is made, and *Melissa officinalis* is cultivated for the bees. *Organum vulgare* is used for dying wool purple, and *Juncus acutus* is grown for the manufacture of mats and cordage, but too limited in extent to afford any opportunity of examining its culture.

We cannot hear of any insect upon the orange or lemon. The olive appears to be infested by an insect, which caused knots upon the limbs, similar to those which grow upon our plum trees. There is also an insect, something like the curculio, which destroys the kernel of the olive. They are sometimes collected and destroyed by beating the tree. There are also knots upon the olive similar in character, though not in shape, to the knees of the cypress, which are so much dreaded by travelers in our southern swamps. These are about the size of two hands, and are planted to produce young trees. It is difficult to obtain them in any quantity, on account of the unwillingness of proprietors to have their trees mutilated. The olive grows fast in a warm climate, but very slow in its northern limit, which is about the latitude of Lyons. Those from the north, would doubtless be most successful in the United States. The Lucca oil is considered the best, from the fact that a superior quality is made from trees grown in high situations, where ice is often found. Slopes of our Alleghanies present favorable sites for this culture. The high lands are also esteemed best for vines, and produce the finest wines, although the plains yield more abundantly.

Near Catania is a highly-cultivated region, with vineyards of great extent, and large fields of grass, wheat, flax, lupins, &c. The vines were about four feet apart, and men were plowing between them both ways, while others, with hoes, were drawing the earth away from the roots, as in Cephalonia. Many of the plants were of great age, with stems three or four inches in diameter, and each branch pruned down to one or two eyes. Orchards of lemon and almond trees were there, and the earth drawn from their roots, laying bare a circle sometimes ten or fifteen feet in diameter. The soil is decomposed lava, black, like peat, even on high lands, and must be wonderfully fertile. In many places dykes were formed to catch the rain and keep it upon the vines as long as possible. We crossed many beds of mountain torrents several hundred feet wide and running into the sea. Near Catania an immense stream of lava, a mile wide, is piled up in masses, upon which nothing will yet grow, except here and there a cactus, the acrid nature of which is said to aid in disintegrating the mineral.

As we approached Catania there were evidences of higher cultivation, and pleasant-looking country houses, with their gardens, were frequent. Fields of mustard, with their light and vivid green, had a growth of a foot even thus early in February; indeed, all the vegetation evinced the richness of the soil and the tropical nature of the climate.

Oranges and lemons were abundant, and we occasionally ate some Indian figs, which were pleasant, but rather too sweet. The sharp spines with which they are covered render gloves necessary in handling them. The best fruit we found here were some delicious pears, sold at a cent each, and the Limoncelli apple, which grows upon the slopes of Mount Etna, and has a delicate sub-acid flavor.

In the vicinity of Palermo we visited the agricultural school, commenced in 1848 under the private endowment of the Duc Castel Nuovo of $5,000 per annum. The director receives $500 annually, the chaplain, who also teaches, $225, and the Lancasterian teacher $90. It is

connected with 130 acres of land, composed of red calcareous soil, alluvial and rich. The plantations of manna and saffron were the most interesting. The ash trees for the manna were planted ten feet apart, and the bark on one side was full of incisions, from which the gum had issued. There were good plantations of oranges and lemons, but it was too early to see their growing crops. The building is Grecian, of very tasteful design, with bed-room, dining-hall, and school of ample size. A very fine collection of 230 varieties of the woods of the island was shown us. The ornamental grounds are tasteful, with trimmed cypresses, seventy years old, and walls painted with good landscapes, above which rose at a distance the real mountains. A flower-garden, in the French style, a statue, and groups of shrubs, aided the effect of the scene. There are twenty-six pupils, four of whom are charity, the others paying about fifty dollars a year, which sum includes clothing, board, and tuition. Three meals a day are given them; breakfast an hour after sunrise, consisting of bread, with fruit, cheese, or sausages; dinner at noon, of wine, bread, and soup, with meat three times a week, and on the alternate days beans and maccaroni, with a ragout on the Sabbath; supper at eight, of bread and cheese, salad, and boiled greens. Napkins were provided, and the table-tops were of marble. Five hours a day is devoted to practice in the field, and four hours in the school to scientific studies.

AGRAMI.

Oranges, Lemons, and Citrons.—Of these, the best known and most generally cultivated are the common orange and its varieties, the blood orange, the Seville or sour orange, and the bergamot; the common lemon, the sweet lemon, and the bergamot; the Florence citron, distinguished by its delicate, grateful, and highly-scented oil, contained in the rind, and the imperial citron, a rough, irregular fruit, growing to a great size, and chiefly cultivated as a curiosity. The citron is cut in two, placed in salt water ten or twelve days, then laid down in salt, and sent thus to Leghorn, Genoa, and France, to be preserved in sugar. These, and all the varieties of the citron family, require a warm climate, a rich, loamy soil, somewhat loose, and an eastern or sunny exposure. Stable manure is used freely, and the best fruit is grown on the richest soil. An abundant supply of water is also requisite, especially for the lemon species, whose roots, spreading horizontally and rarely striking deep, are most exposed to the burning heat of the summer. In preparing for a plantation, the ground is made gently sloping, with just enough descent to allow water to run, and is then dyked in eight feet squares. Every week or fortnight after being planted, according to the weather, water is turned on the highest of these, and then on each lower one, successively. This is continued all summer. As the same water is used by many, some irrigate at mid-day, and do not consider it injurious. The trees are grown in nurseries, and when of sufficient size are planted in orchards, fifteen feet apart. The lemon, from its more straggling growth, will do better at twenty feet. The fruit from ungrafted trees grows larger, and is esteemed as good as that from grafted trees for home consumption.

The latter, however, are preferred, for several reasons. The natural fruit is more delicate in its texture, matures quicker, and will not keep so well for exportation. It is also thorny, and wounds the fruit. Trees are sometimes grown from cuttings, but are thought to bear less and to be of shorter duration than those from seed. The trees may be raised from seed, or propagated by layers and young branches. When the plants are cultivated with attention and skill, they come into bearing in four or five years. In ten or twelve years a moderate crop is annually produced, and at from twelve to twenty they may be considered in full bearing. An average-sized, adult tree will produce from twelve hundred to two thousand fruit, although there are many larger trees that will yield from four to six thousand. Of these, one sixth are unfit for exportation, and are used for home consumption or cut up for lemon juice and oil. From the flowers of the orange an agreeably-scented water, well known in commerce, is obtained by distillation. The bitter peel of the sour or Seville orange, as also the orange buds or small fruit which are blighted on the trees of all varieties in the month of June, afford a considerable article of commerce. They are dried, and shipped to Germany and other parts of the north, where they are either consumed by the brewers of malt liquors or converted into cordials by infusion or distillation over spirits. The fruit intended for exportation is gathered with the greatest care, and deposited in baskets lined with sacking or hemp cloth. The sound and most perfect being selected, they are wrapped in a light-brown, thin paper, imported from Genoa and Trieste, the rags composing which go from Sicily. Large sums are sent annually to Genoa for its purchase. They are then packed in light boxes, double-lined with this paper. This gathering and packing continues from November to March, and is done by men, women, and children, in the country, under a contractor, who receives eight cents for each box of three hundred and sixty. In this shape they are brought to the city store-houses, where, after remaining eight or ten days, they are all unpacked and examined, and any orange or lemon showing the least scratch or blemish is cast into a bin, to be sold in small quantities to the city retail dealers. The perfect ones are then again wrapped and packed as before. If, by some accident, they are not shipped, the same process is repeated every two weeks, so that when shipped they are always perfect, and likely to keep for a long time. The assorting and wrapping by women, at eighteen cents a day, and packing by men, at thirty-two cents, requires some skill and dexterity to suit the numbers contained in the cases to the customs of the country to which they are to be sent. Each case is divided across the middle into two equal parts, in each of which the fruit is arranged in five tiers. Children are employed in smoothing the papers taken from the fruit in the unpacking, and these children earn about two cents per day beside fruit enough to eat with their bread.

Of lemons intended for England and America, the usual number in such cases is three hundred and sixty; of oranges, the size of the case for which is smaller, the number is two hundred and forty. The first shipment of lemons, called "*di primi fiori*," takes place in September; they are considered much inferior to the subsequent gathering, from November to January, as they have a hard, thick rind, and contain

little juice. These are mostly sent to Trieste, and to the markets in the Mediterranean, while some few find their way to England, as early shipments. Lemons for exportation should weigh at least three and a half ounces each, have a firm rind, moderately thick, abound with acid juice, and not be unripe. For this latter quality, the fruit which is gathered and packed green, in the early part of the season, is greatly to be preferred for foreign markets. About the month of January, the lemons, approaching to maturity, begin to change their color on the tree, from which time they gradually decline in quality for long voyages, until the month of March, when, the trees being exhausted of their fruit, the gathering season closes until the new crop comes round. A sufficient quantity of fruit is always kept upon the trees for home consumption until the next season. The most considerable, and sometimes the most valuable portion of the fruit, is the *scartito*, or that rejected as unfit for exportation, from which the essential oil, contained in the rind, and the juice or citric acid in the pulp, are extracted. The essential oil is expressed by the hand, in a room from which the air is carefully excluded, as, owing to its highly volatile nature, the oil produced would be greatly diminished by currents of air. The skin cut from three sides of the lemon is pressed between the thumb and finger, and ten or twelve ounces may be expressed in a long day by an expert and steady workman. The oil thus expressed is put into large receivers, whence (after remaining some days to deposit the extraneous matter that comes off with the oil) it is transferred to copper bottles, for exportation.

The juice, or citric acid, is obtained by submitting the pulp to a powerful press, which, though rustic in construction, is efficient. This is worked during the season night and day. The quantity of juice produced from one press during twenty-four hours averages one hundred and twenty-six gallons. In the average of the season, it requires from ninety-five to one hundred and five lemons to produce a gallon of juice. The amount of the annual produce cannot easily be ascertained. The produce of the district of Messina, including imports from the opposite coast of Calabria, is stated at two hundred and forty-two millions of gallons. In seasons of great demand, any quantity may be purchased, the requisite amount being fraudulently made up by water mixed with the juice of the sour or Seville orange and that of the sweet orange taken in its green and immature state; sometimes the adulteration is with the juice of unripe grapes.

Lemon juice intended for exportation is put into strong and well-seasoned oak casks, and filled to the bung, so as entirely to exclude the air. When the lemon juice is originally of a good quality, and the filling of the casks is completed, the article may be kept in a cellar, or cold place, for any reasonable time. By injudicious management, rather than from natural defect, lemon juice shipped to foreign markets was formerly spoiled before it reached its destination. To obviate this evil, a British merchant established in Messina, in 1815, a manufactory, on a large scale, for crystalizing the citric acid. This process, however, being found expensive for consumers in general, a new mode was introduced, of evaporating the juice over steam, in leaden pans, four or five feet in diameter, by which the watery parts

of the juice being thrown off, there remained nothing but the citric acid and mucilage, in a highly-concentrated state. This was found to answer the purposes of calico printers and other great consumers so completely, that almost all the lemon juice now shipped from Sicily is boiled down to any given strength; the degree of that strength, ascertained by a hydrometer contrived for the purpose, determines the amount of the duty to be levied on the import.

VINE.

Unlike some other vegetable productions of the island, the cultivation of the vine is not limited to any particular district or aspect. It flourishes equally well on the mountains and in the plains, on the sea-coast and in the interior, in the north and in the south.

The difficulty of transportation in so mountainous a country as Sicily naturally promotes the most extensive cultivation toward the coast. That in the interior is principally limited to the vicinity of large towns, for the consumption of the inhabitants alone.

Generally speaking, the black grape predominates throughout the island, and from this and the white, too often planted promiscuously, an endless variety is cultivated in every province. In laying down a new vineyard, the land, which should slope southerly, is first well cross-plowed, in the month of November, and allowed to rest till the middle of January. Trenches are then dug, about five feet deep and from four to five feet apart, which are left open to ventilate about fifteen days. The plants, which are vigorous cuttings of the former year's growth, taken from some neighboring healthy vineyard, and generally from eight to ten feet long, are placed upright in the trenches, at a distance of five feet apart, the trench being then filled in to the depth of three feet. The upper end of the cutting or *maglinolo*, as it is termed, is then turned down with its point stuck into the ground to keep it fresh. As the season advances and the plant begins to vegetate, the remainder of the trench is from time to time filled in. In the succeeding winter the plants are attentively examined and pruned, leaving the most vigorous shoots only with not more than two eyes or buds. The vineyard is then hoed up and kept clean from weeds, till the end of May or June, a cavity being left around each plant to receive the rains. The same cultivation is continued for the second and third years, before which the plants do not show any fruit. The fourth is generally considered the first year of produce. In those districts where canes are to be had, the plants are staked in March and April, to which the shoots are attached as they advance in growth, to protect them from being broken by the strong northeast winds which prevail in June. From six or seven years to twenty a vineyard is considered in its prime bearing, though there are many favored by rich soil and judicious management, which remain in full bearing forty and even fifty years. If the plantation is good, the produce of one thousand vines, in the seventh year, will be two hundred and thirty gallons of wine. Where the proprietor holds the vineyard in his own possession, the average annual expense of cultivation may be estimated

at from two dollars and fifty cents to three dollars and fifty cents per thousand.

When the owner is an absentee, or puts his vineyard into the hands of a *metayer*, this latter is expected to reside on the spot and perform all the labor, for which he divides the vintage with the landlord in equal parts, measured at the press. The expense or cost of the canes is borne equally by the landlord and metayer, and cuttings are also divided in equal portions. These agreements are always in favor of the landlord, as, the metayer being unprovided with casks or stores to deposit his portion, the whole goes into the hands of the landlord, who, about Christmas, holds a meeting with other landlords of the same district, when a price is fixed at which they are to settle with the metayers, deducting one half the expense of the vintage. The price is always much under that at which the wine may be sold when matured, but the landlord considers himself entitled to this advantage for the expense of providing casks and stores, the possibility, in unfavorable seasons, of the wine turning sour, the bursting of casks, and similar accidents.

The vintage toward the coast commences, in favorable seasons, from about the 20th to the 25th of September, but in the mountains and the interior a month later. Every vineyard of any extent is provided with a *palmento* and wine-press, generally constructed in some shed or convenient out-house adjoining the dwelling of the metayer. This consists of a substantial stone cistern built upon the floor of the press room, about three feet deep, and proportioned to the extent of the vineyard, having an opening at the bottom, or one side, into which is introduced a stone gutter, projecting over a well sunk in the ground, and immediately under the wall of the cistern above. Sometimes a wooden cistern is used, which is cheaper, and better adapted to our economy. The grapes being gathered and thrown into this cistern, are trodden by men, when the juice flowing through the gutter is received into the well below. This treading is kept up as long as any juice continues to flow, when the husks are collected and heaped in the middle of the cistern. Being covered with strong planks, they are then submitted to the press. This consists of a beam of timber, from twenty to twenty-four feet long, one end of which is let into a hole, purposely built in the wall, and to the other is affixed a vertical screw, with a huge stone attached, weighing from twenty to twenty-five hundred weight. This beam passing over the husks, which have previously been collected in the middle of the palmento, subjects them to a most powerful pressure, when the stone is suspended by the winding of the screw. When no more juice flows from the pressure, the husks are removed, and the must conveyed to the magazine. The produce of this pressing, which brings out the coloring matter from the musk, is, in a commercial point of view, considered essential in the quality of the red wines. So much is a deep color thought desirable in these wines for a foreign market, that it is a custom, in many parts, to spread the husks again upon the floor of the palmento, and return the must thereon, leaving it two or three days to ferment, thereby more effectually incorporating the coloring matter with the wine; but the practice is injudicious, as it imparts to the wine a harsh, acid taste, acquired

from the stalks. For white wines, the husks and stalks are excluded in the fermentation.

A good vineyard, in favorable seasons, will produce about four hundred gallons of must per thousand plants; but an average of the whole island cannot be calculated at more than two hundred gallons. The places for the exportation of Sicilian wines are Messina, Melazzo, Riposto, or Mascali, Catania, Syracuse, Mazzara, Marsala, and Palermo. Those of Messina and Melazzo are all red, or, according to the term of the country, *black* wines. Very little of the white grape is cultivated, and that chiefly intermixed with the red. In the neighborhood of Savora, about twenty miles south of Messina, and from Riposto to Catania, and thence to Syracuse, including that district, the cultivation of the white grape predominates; hence the shipments from those ports are principally white wines, and the quality full-bodied and strong. A description of muscat is made in Syracuse, and much esteemed for its rich and luscious flavor.

The most esteemed wines of Sicily, and the most important in commercial rank, are the celebrated white wines of Marsala, Mazzara, and the adjoining territories. As far back as 1789, John Woodhouse settled at Marsala and laid the foundation of the first establishment for those wines, which have since obtained the highest reputation. It is said, however, that the success of this speculation was in the outset very equivocal. The first shipments were made to America, where it gradually acquired reputation; and about 1802 it was introduced into the English fleet, then under the command of Lord Nelson, in compliment to that officer acquiring the appellation of Bronte Madeira; under which denomination considerable shipments were subsequently made to England. Five other establishments were afterwards founded, and have proved very profitable. Each of these gives employment to numerous workmen. In those of Woodhouse and Ingham, about one hundred, and in those of others, from fifty to seventy, are in constant attendance, whose wages and allowance are liberal. A visit to one of these establishments is always interesting. The great extent of the premises, the neat arrangement of the work-shops, the close attention of the principals, and the incessant activity of the cooper and smiths, make an impression on the visitor; the strength of which is heightened by the appearance of the wine stores, where from ten to twelve thousand pipes are ranged, tier above tier, extending to a distance of several hundred yards. The daily earnings of a family, consisting of a father and four sons of various ages, might be estimated as follows:

Father	28 to 32	cents.
Son, seventeen years	20 to 24	"
Son, twelve	12 to 14	"
Son, eight	8 to 10	"
Son, five	2 to 4	"

Each adult is allowed fire-wood for cooking his food, besides two and a half quarts of wine, and a small quantity of oil, per day. Each boy has the same allowance, excepting wine; his ration of which is about one quart per diem.

The annual produce in Marsala and that territory is estimated at about twenty-four thousand pipes, of which one half is supposed to be consumed in the country. As the grape is a mixture of both white and black, the wine, in its primitive state, would be approaching to pale-red or cherry color. Artificial means are therefore employed to reduce the color; and though much mystery is affected in the subsequent management, and each establishment pretends to a process peculiarly its own, the main secret may be said to consist in frequent rackings from the lees, taking care never to disturb it in the spring, or during the prevalence of the sirocco or southeast winds. There is also a gradual reinforcement of clean spirit; for the preparation of which, each establishment is provided with the most modern and approved retort. Three or four years are required to make it marketable. The neighborhood of Palermo and the surrounding territory produces abundance of most excellent wines in great variety, both red and white, which are brought into Palermo and prepared for foreign markets. No less considerable quantities, destined for exportation, are likewise brought along the coast to this port, whence extensive shipments of white wines are annually made to South America, England, and the United States.

SUMAC, OR RHUS CORIARIA.

Is a small shrub, growing from two to three feet in a season, and used for its stringent qualities by tanners and dyers. The cultivation is confined chiefly to the vicinity of Palermo and Alcamo, the last being esteemed the best. It is sometimes adulterated with the leaves of the leutish and myrtle trees. A soil of moderate depth is required, and not too rich; for if the growth is too luxuriant, the tannin in the plant becomes diluted. Manure, therefore, is never used. Stony ground will do very well, although the sumac near Palermo was on good rich loam. It will not bear much water, and is therefore better on a hill-side, with a southern exposure, as the more sun it receives the stronger will be the tannin. It could doubtless be grown with profit on the dry lands in our southern States. The proper adaptation of the land can be ascertained by testing the leaves with sulphuric ether. In the best sumac, one hundred grains of the powdered leaf should give thirty to thirty-five grains of pure tannin. Use as much sulphuric ether as will dissolve the sumac, or pass it through the sumac till it runs clear, then draw off the ether by heat, and the deposit will be pure tannin.

The soil is prepared as for potatoes, with furrows from two to two and a half feet apart, in which in January or February are placed the young suckers two and a half feet apart. In August, of the first year, the leaves on the lower part of the branches are drawn off with thumb and finger, leaving a tuft on the top. In October the whole head is taken off, or sometimes broken, and left hanging by the bark till dry. The second year, in June, the branches are stripped of ripe leaves; and in August, as soon as the whole plant is mature, it is cut with a sickle down to six inches; it is then spread out, dried thoroughly on each side till entirely cured. The June gathering is omitted in many

cases when the plants are not strong. After being dried, the branches are put upon a floor and threshed, when the leaves will separate from the wood, which is of no value except for fuel. The leaves are then ground between two mill-stones, one of which is on edge and revolving around a center. We visited a mill driven by steam power, which threw out the powdered sumac in large quantities. The air was filled with fine particles of dust, which covered our clothing and entered the lungs. It is not injurious, however; for, although it seemed suffocating, the workmen will sleep three or four hours successively in it and are always remarkably healthy. They were particularly exempt from cholera.

The leaves are readily reduced to powder, while the stems are not. These last are then separated by sifting, and the pure sumac is placed in bags of one hundred and sixty-three pounds each for shipment. A sumac plantation will produce a good article for ten years, and a poorer for ten years longer. The same soil will not bear sumac a second time, unless cropped by something else for twenty years, nor is it then so good as land on which sumac has never been grown. It requires the usual cleaning, and is hoed in December, March, and May. Two thousand pounds of ground sumac to an acre is considered an average crop.

BARILLA, OR SODA.

The cultivation of this alkaline plant, which is attended with considerable expense and requires great labor and care, has lately been much neglected, as its present value will hardly remunerate the grower. Since the introduction of chemical bleaching, the demand for Great Britain, Ireland, and America, has become very limited; while in France the extended use of *soude factice* has almost exploded the consumption of the vegetable production. The favorite soil of this plant is a fat and putrid earth, and it requires an exposure to marine exhalations, on which the quality much depends. The best is that of Trapani and the Island of Ustica. After these Terranova, on the south coast. The produce of the latter district, however, is supposed to be affected in its quality by the sirocco winds, it having been observed that in seasons when these winds prevail it is much inferior.

The superiority of the Ustica barilla is said to be owing to the burning of the plant before it is thoroughly dry; but, if this were the sole reason, the peculiar process would naturally be adopted elswhere.

Owing to the state of the roads, I was unable to reach a barilla plantation even on horseback, but was promised a detailed account, which has not yet reached me.

OLIVES.

The cultivation of the olive may be traced among the earliest objects of Sicilian industry, and its fruit has ever been considered one of the principal sources of national wealth. Only two varieties appear to be generally known or cultivated in Europe. The *Olea longifolia*, the spear, or long-leaved European olive, which is chiefly cultivated in

the south of France and many parts of Tuscany and Piedmont. From the fruit of this species, which is of a bright, lively green, oval and of a roughish skin, we are furnished with that delicate oil so much esteemed for our tables.

The *Olea latifolia*, or broad-leafed European olive, is the species cultivated in Sicily, Italy, and the Kingdom of Naples, where the trees grow to a much larger size than those of the other variety. The fruit or berry is also much larger, rounder, smoother skinned, and more fleshy, than the olive of France, more productive in oil, and though much stronger and less grateful to an American palate, arising from an improper mode of treatment, is, nevertheless, from its rich and unctuous quality, better suited to manufacturing purposes.

The usual mode of propagating the olive in Sicily is by grafting upon the wild olive, or from strong, healthy shoots, which are thrown up about the roots of the old plants. These latter, being detached with a portion of the parent root in the months of January and February, are planted twenty-five feet apart, in holes four or five feet deep, previously opened and prepared for their reception, and in ten years will become bearing trees. The mountain shores, on the northern coast of the island, seem peculiarly favorable to the growth of the olive. Along the whole extent of this coast, we saw the sides of the mountains and intermediate valleys entirely clothed with it; while in the interior of the island and on the southwestern coasts, it is rare to find a few small and straggling plantations. Hence, almost the entire produce of oil in Sicily is collected along the northern coast, extending from Cape Gallo to the Paro of Messina, and thence to Taormina, about two hundred miles, including Palermo and its dependencies. From the quantity of oil made on the estates of small proprietors, and consumed for domestic use, it would be difficult to give any accurate statement of the entire annual product, though it has been estimated that the above-mentioned districts collect, in favorable seasons, from seventeen hundred thousand to twenty-two hundred thousand gallons, of which four fifths is required for home consumption.

Many incredible tales are related of the extraordinary duration of the olive; but there is no doubt that, when carefully cultivated, it will continue to produce fruit and remain in healthy vegetation for centuries. Trees are now living, which are said to be seven or eight hundred years old, and several are designated in a title deed drawn up in 1610. The flower, which is a small cluster, not unlike that of the grape, is put forth from shoots of the former year's growth, in the month of June. In July the fruit begins to set, and from that to the end of August is considered the most critical time for the crop, to which nothing is at that time more injurious than the rains. From this cause, and a prevalence of east winds, the fruit during that season is very subject to blight, and to be infested with a small insect which, penetrating the skin, produces a worm or grub; this consumes the pulp within, leaving little more than the nut or stone covered with the outer rind. As no means have been discovered to check its progress, in a few days the most promising crops have been rendered of little value. Of all the vegetable productions of the island, none is considered more precarious than the olive, even under the most favorable

circumstances and seasons. An uninterrupted succession of crops is never to be calculated upon, it being an admitted fact that every third year will be one of scarcity or sterility. In some districts, many extensive plantations have often been altogether out of bearing for many years, without any apparent cause, and to the utter ruin of the proprietors.

Toward the coast, the season of gathering commences in the month of October. This work is continued from this time until the month of December and even January in some of the districts situated higher up the mountains. The fruit is at first shaken from the trees, and finally, toward the latter end of the season, beaten from the bunches by long poles or canes. At each respective gathering, women and children are employed to collect the fruit from the ground, whence it is conveyed to appropriate stores, and cast into large bins or receptacles, prepared for the purpose. Here it is left to sweat and ferment for many days, until it becomes black, and has all the appearance of approaching decay. This practice, so destructive to the quality of the oil, is nevertheless general, as it is erroneously supposed to increase the quantity. In this state it is conveyed to a mill, where it is first ground to a paste under heavy stones, and chaff or small straw occasionally thrown on, to retain the oil. The pulp is then rammed into round, flat baskets, made of a strong kind of rush, and submitted to a press. When the oil ceases to run from this first pressing the baskets are removed, their contents again passed under the mill, thence a second time returned into the baskets, submitted to the press as before, and in like manner, a third and last time. In these final pressings, hot water is thrown upon the baskets as they are piled under the press, the more readily to disengage the oil, which, flowing out with the water, as the press is let down, is conveyed to the tub or cask sunk in front, where the oil, swimming on the surface, is carefully skimmed off. Whatever now remains in the baskets is thrown aside, as the perquisite of the workmen, by whom it is collected and left some days to ferment, and then submitted to another pressure, which yields a small quantity of very bad oil, used by curriers and leather dressers.

Although the mode here described is that in general practice for extracting the great mass of oil produced for commerce, there are many intelligent men who, for private consumption, are more refined in their process. By pressing their fruit fresh, as gathered from the trees, without leaving it to ferment, they obtain an oil nothing inferior in quality to that of Lucca. From the many samples of fine oil found at the tables of the most respectable Sicilian families, it may be safely inferred that the bad repute of Sicilian oil arises from the unscientific mode employed in its preparation. By proper attention to this point alone, the olives of Sicily are as capable of yielding as good oil as the boasted produce of France and Tuscany.

THE INDIAN FIG

Is the *Cactus opuntia*, which makes so conspicuous a feature and gives so tropical a character to a Sicilian landscape. Although somewhat ugly, it is strikingly picturesque. The leaves are nearly half

an inch thick, large as a mullen leaf, of a dull green color, and free from prickles. Without stalk or stem, these leaves grow one out of another, agglomerating into an irregular mass, like a rock with cavernous vacancies in its sides. This vegetable mass bears a yellow flower, which becomes a fig-like fruit, with a red, sweetish pulp, much eaten by the natives.

It is generally planted in belts, from two and a half to three feet wide, and from ten to fifteen apart. Across these belts the cactus leaves are placed, touching each other; they very quickly take root, and produce new foliage. It will grow in poor and dry soil, and, with asphodel, is the first plant upon the lava, for which it is the most valuable, breaking it up with its strong acrid roots.

It bears the third year, and has a full crop in ten years. Its net profit is estimated at from thirty dollars to fifty dollars per acre, as it will produce two crops a year, one hundred and fifty to three hundred bushels per acre, and sells readily at wholesale at from twenty-four to thirty cents per bushel. It is one of the most useful plants on the island; the tree serves for fences, the leaf for receiving the liquid manna, and the fruit for the consumption of all classes.

ALMONDS.

Almonds are grown in greatest abundance at Avola and Girgenti, and are of both kinds, sweet and bitter. The trees are propagated from nuts and cuttings. The nut it planted in the spring or autumn, and the young trees transplanted at the end of a year to the nursery grounds, to be grafted in the second or third year. The cuttings are planted about fifty feet apart, and are grafted at six years old, four years after which they come into bearing. Attaining its full growth at fifteen years, the tree continues in its prime until thirty, when it begins to fall off, and perishes at sixty years. The flower appears in January, the fruit ripens in May. Of the sweet almond, the best sorts are those of Mascali and Avola, which are equally remarkable for whiteness and flavor. The shell is used for fuel.

SAFFRON.

Saffron grows wild in various parts of Sicily. The soil most congenial is a loose, calcareous earth, free from clay. Planted in furrows, about a foot apart, the bulbs produce a violet colored flower, which is gathered in October. The three pistils are collected and dried. The stamens are thrown away as useless. The bulbs require to be transplanted every third year.

MULBERRY.

The red mulberry is the species chiefly cultivated in Sicily, the white being much neglected. The fruit is of little value, and grown only for the silk-worm. The *Celso filippino*, a species recently introduced, comes into leaf about three weeks before the white, and six before the

red. The growth is very rapid, but is never allowed to exceed twelve feet in height, at which elevation the tender leaf can be gathered by children.

SILK.

The production of silk in Sicily is almost entirely confined to the northern and northeastern coasts. From Catania, its southern limit, this branch of industry goes northward, as far as Taormina and Messina, proceeds eastward to Melazzo, follows the line of coast to St. Stefano, turns a little southward, and terminates at Mistretta. The whole produce of these places, and all the intermediate villages, finds its way to the Messina market, except what is retained in Catania, for the use of the Catanese looms. None is produced in the interior, and but a very small quantity in Palermo and its neighborhood. The annual produce is estimated at thirteen hundred bales, or three hundred thousand pounds. This is exclusive of floss or waste, which is estimated at one hundred thousand pounds more.

SILK-WORMS.

The appearance of the worm, in its natural course, takes place about the middle of April; but, in seasons when the vegetation of the mulberry tree is unusually backward, it is artificially retarded until the leaves are ready. When this cannot be accomplished, the leaves of the blackberry and the lettuce, which merely keep it alive, are given to the worm, until its natural food, the mulberry leaf, is ready and plentiful. This, in Messina and its dependencies, which chiefly form the silk district, is almost wholly the leaf of the red species. In Calabria, the white mulberry, which leaves out three weeks earlier than the red, is used, until the first and second change, when the white becomes hard, and the red is substituted for it. Those fed on the red, yield a greater quantity of a stronger silk than those fed on the white, but the silk of the latter is finer and of a brighter description. The quantity consumed by the worms, from the time of their coming into being, to the fourth and last change, bears a great disproportion to the amount of silk produced. One hundred and seventy-five pounds of leaf yield only thirteen ounces of silk. In Lombardy, one hundred and twenty-six pounds of leaf yield one pound of silk; in Sicily, two hundred and fifteen pounds of leaf, one pound of silk.

The fourth and last sickening, or change of skin, is considered the most critical; nor are the worms deemed out of danger until they have climbed the arbor and spun the cocoon. The intestines of such as die in the changes are made into thick thread and sold under the name of "silk-worm gut" to American seamen and others, for making fishing tackle. A small portion of the cocoons, according to the extent and demand of the establishment, is put aside for eggs, the grubs of which, when transformed into moths, are allowed to eat their way out. Those intended to be wound off must be destroyed, in order to obtain the silk unbroken. The usual mode of effecting this purpose is by placing the cocoons in a slow oven. This practice greatly hardens

the gummy matter which covers the silk on the cocoon, and renders it more troublesome to detach, in winding. To obviate this objection, some establishments in Messina have adopted successfully the following ingenious contrivance, which, from its simplicity and efficacy, is worthy of notice: In a small closet, erected in some corner of the establishment, a copper boiler is fixed over a furnace. From the ceiling of this closet, shallow baskets, attached to each other, and filled with cocoons, are hung up in succession, until the lowermost nearly touches the boiler, previously filled with water. A sliding door in front, which is made to fit closely, is now let down to touch the edge of the boiler, and so secured that the steam shall not escape. The water is now made to boil, and so kept up for about half an hour, at the end of which time the fire is withdrawn and the whole left quiet another half hour. During this period, the condensed steam from the cocoons, with a great portion of the gummy substance from the silk, which has been dissolved by the steam, is drained off into the boiler below. The cocoons are then removed to the floor of a chamber and left to cool, after which they are placed on a terrace, where they are exposed to the full heat of the sun, until thoroughly dried and prepared for winding. Meanwhile, the steam-closet receives a fresh charge, and the operation is repeated, until all the grubs are killed. From the cocoons eaten through, a silk, called *calamo di semenza*, is obtained, by carding, and which, in quantity, is equal to one fourth, and in value to three fourths, of the ordinary or net silks. Another and inferior description, called *calamo di fuori*, is taken from the outer part of the cocoon, before the silk is wound off, the value of which is about half that of the common.

The calamo of both sorts is exported to England, where it is made into hosiery and shawls. In Sicily it is spun by hand and woven into ticking, for mattresses, and into coarse stockings and gowns, for the use of the female peasantry.

MANNA.

The manna-ash grows chiefly near Palermo, and is propagated from seed, or cuttings. The former is preferable, the tree being of rapid growth and soon coming to perfection. Manna is the coagulated juice, or sap, which oozes out of the *Fraxinus ornus*, a species of ash, indigenous to the northern coast. The tree, at its full growth, is from twenty to twenty-five feet high, borne on an upright stem, with smooth bark, about eight feet in height, and about two and a half in circumference. It is well-known, with us, as a hardy, ornamental tree, with clusters of flowers. The manna is obtained in the months of August and September, from horizontal incisions made in the bark about three inches long and half an inch deep. Under these incisions, and quite close, another slight cut is made in the bark, in which is inserted a leaf of the same tree, serving as a gutter to conduct the sap into a receiver placed on the ground at the foot of the tree. This receiver is nothing more than the dried leaf of the *cactus opuntia*, which is ten or twelve inches long and about eight inches broad. When dried, it assumes the shape of a hollow dish, sufficiently capacious for the purpose required. These incisions are begun at the bottom of the tree, and each

day a fresh one is made, two inches above the first, and so continued during the "raccolta," or gathering, which, in favorable seasons, lasts about six weeks.

When the incision is first made, the manna flows in a watery, limpid state, but gradually thickens as it is exposed to the air and the heat of the sun, which at this season is intense.

This is deemed the best and finest quality, and called "manna in tears." After it is collected, and the leaf removed to a fresh incision above, the sap continuing to flow down the bark of the tree is concentrated thereon, and forms a second quality, which is afterwards carefully detached with a knife. This is distinguished in commerce as "manna in flakes," the quantity of which is by far the most considerable part of the collection.

A third and inferior quality is collected, called "manna in sorts," composed of the refuse, or broken collections from the two preceding, that which has accidentally run upon the ground, or been damaged by rain, and that which flows at the end of the season, when the heat of the sun is insufficient to concentrate it. The quantity and quality of this article depend upon a hot and dry season. As the operation is necessarily exposed to the weather, a rainy or damp season will greatly diminish the quantity of the crop, and often entirely ruin its quality, since, once wet, it cannot be dried by any artificial means. The first two qualities are usually shipped to England and the United States; the latter, and inferior, to the Adriatic markets, and those of the Mediterranean. Other countries are provided with this drug from Naples, which draws its supplies from the southern coast of Calabria. In the plantation which I saw the trees were ten feet apart, but appeared too close for healthy growth.

CAROB TREE, OR CERATONIA SILIQUA.

The carob was noticed in my report on Cephalonia, as being one of the finest ornamental trees. Its fruit is somewhat like that of the honey locust, or *Gleditschia*, and its pod full of a sweet, rich pulp, covering a nutritious bean. It is eaten here, as at Cephalonia, both by men and cattle. A preserve is made of the juice, boiled with sugar, and spirits are also distilled from it. Most of the produce goes to Naples. It is rarely cultivated in large quantities, and the fruit is mostly collected from natural trees. A few specimens on a place will often be found grafted with a superior variety. Its native habitat seems about Syracuse, where it is found in considerable quantities.

PISTACHIO NUTS, OR TEREBINTHUS INDICA.

The pistachio tree springs up in rich soils, in the central districts, and also in the volcanic humus, in the region of Mount Etna. Grafted at six years old, it comes into bearing at twelve, and produces a fair crop about once in three years, until a very advanced age. A male scion, grafted upon one female in an orchard, is sufficient to fecundate the whole. The nut, gathered in September, is exposed to the sun until perfectly dry, as the least degree of moisture causes it to rot.

ALOE.

This conspicuous plant, equally useful and ornamental, abounds in all parts of Sicily, but is found in the greatest perfection in the southern and central districts. Planted in favorable soils, it attains the height of eighteen to twenty feet, and flowers in seven or eight years, after which it immediately dies away, leaving suckers behind to continue the succession.

It serves for impenetrable fences, the stems for rafters of huts, and the leaf for domestic manufactures. The leaf, steeped in water until perfectly tender, crushed between cylinders, soaked for some days in a stream, then beaten and combed out, yields a thread which is used for various purposes.

CORK WOOD.

Cork oaks of stunted growth are found in the woods of Sciana. The outer bark, unfit for bungs and stoppers, is used chiefly for fishing tackle; the inner, equally valuable with common oak bark, is used in tanneries, to protect which branch of industry, the exportation of cork wood, except as dunnage, is strictly prohibited.

GUADO.

This dye plant is sown in autumn, and gathered in May. The leaves, ground at the mills and kneaded with the juice, are worked into balls, which, when dried in the sun, are used in giving linen a light-blue color.

FIGS.

These are of poor quality, not so well suited for exportation as those of the Levant. No alkaline solution is used in their preparation; they are slit, and dried on strings, mostly about Messina and Calabria.

TOBACCO.

This plant is produced in gardens around most of the principal towns. The best soil for its cultivation is a good, rich loam, and the best situation a slope with a southerly exposure. Sown in the winter, it soon comes up, and gradually advances until the crop requires to be thinned. The sprouts transplanted are set about twenty inches apart, in ground well watered and manured. The blossoms are nipped off, and the shoots cut away as soon as they appear, to enable the young leaf to expand and ripen. The maturity of the leaf, which is in summer, is denoted by a change in its color, and the appearance of pustules on its surface. The plant is then plucked up, and the leaf stripped and dried, preparatory to its sale to the dealer for manufacture. The quantity of seed sown is about a gallon per acre; the quantity of leaf gathered about thirteen thousand pounds. Tobacco

was once worth to the government thirty or forty thousand dollars revenue; they increased the duty, and none was imported.

COTTON.

The soil of the Sicilian plains is eminently adapted for its growth. The seed is obtained from Malta, sown in spring, gathered in August, September, and even as late as December. The plant is not liable to blight, but is sometimes injured by the sirocco.

The sea-island cotton seed has been distributed in several districts; some has entirely failed. In one place a little cotton was produced, but the trial was scarcely such as to warrant a decision upon its adaptation to the climate and soil.

CASTOR OIL.

This plant grows wild in many parts, and is much cultivated in the vicinity of large towns for the oil which is extracted from the nut. It is prepared by almost every chemist, for home consumption, to the exclusion of castor oil from the East and West Indies. Were the process properly conducted, the extraction of the oil might become an important branch of Sicilian industry.

LIQUORICE.

The roots of the liquorice plants, which grow wild, are converted into paste by washing, steeping, boiling, and evaporation. The first quality is that of Taormina; that of Catania and Patti is too often adulterated with the juice of the cactus and carob.

OPIUM.

This is nearly equal to the Turkish; has been made by a Sicilian chemist from the wild poppy, which abounds in the island.

LUPINS.

White lupins are raised for fattening cattle, and also as manure for vineyards, being plowed in when a foot high.

SEEDS.

Anise, canary, cotton, flax, hemp, and mustard are the chief. The first three are largely exported; the last three are mostly consumed in the island.

Wheat is of two kinds, soft and hard, the soft used chiefly for household bread, the hard for maccaroni. The seed sown in October and November, at the rate of half a bushel to an acre, yields, in June and July, about eight for one. The average weight of a bushel is about sixty pounds. This grain has been much neglected for the want of

sufficient hardness in the English mill-stones; but since cast-iron and French burrs have been introduced, the wheat here can be made into flour equal to that of the best soft grain. The best maccaroni wheat is called *Giustalisa*, and the next best *Realforte*. At the magazines these were priced to me at $1 50 per bushel. The annual crop of wheat is computed at 16,000,000 bushels.

Oats are raised in small quantities in the southern districts; the return of seed is ten to one.

Barley is found unfit for malting, and is chiefly used as provender for horses.

Indian corn is but little cultivated. A particular species, called *Cinquantino*, ripens in fifty days.

Rice is principally grown in low marshy districts about the plains of Catania, where the lands may be irrigated by the waters of the Giarretta. The quantity is inconsiderable, and hardly sufficient for home consumption. The grain, small and ordinary in quality, may be classed as little better than Egyptian. It must be sown in a deep soil, and kept constantly under water. It produces about six hundred weight per acre of clear rice. This is thrown into a mill, the lower stone of which is lined with cork. The cultivation of this grain is considered an unhealthy occupation. The dry rice of Porto Rico is not cultivated in Sicily. Sown on two occasions, it came up quickly, but owing to inattention was allowed to perish.

Flax is grown abundantly in all parts of the island. The best soil for it is a rich garden-ground. The land requires from three to six plowings, according to the nature of the preceding crops, and good and plentiful dressings with stable manure, or the sweepings of sheep-folds. The sowing generally takes place in November, but occasionally in March, when two salmas, or sixteen bushels of linseed are allowed to one salm, or about five acres of ground. The harvest is usually in May and June, when, in favorable seasons, from thirty to forty bushels of linseed are gathered, together with ten cantars, or about sixteen hundred weight of flax. The plant being drawn up by the roots, the seed is beaten out and sifted previous to shipment. The stalk is steeped in running water for seven or eight days, at the end of which time it is taken out and dried. The crisp bark is broken and removed by a peculiar instrument. The fibre is combed and prepared for spinning with a view to future manufacture. Flax, which in England is supposed to impoverish the ground, is in Sicily thought to have a beneficial effect.

Hemp is much cultivated on the eastern coast, in rich damp soils, or in ground well irrigated. The land is plowed four or five times before the sowing, which takes place, near the coast, in March, but in the mountains in April, when three and a half bushels are sown on an acre of land. The ground requires to be well watered every four or five days from running streams or from reservoirs. The plant, which is delicate, and liable to be cut by the frosts, comes to perfection in July and August. A good crop will yield from seven hundred to a thousand pounds of seed, and from six to ten hundred weight of fiber, per acre. The seed is beaten out, and the fiber prepared for spinning in the same manner as flax. The plant, when taken out of the water in a putrid

state, creates a severe malaria, to escape the effects of which, the persons employed are recommended to sleep among horses and mules. The cultivation of hemp and rice is prohibited within two miles of any human habitation, unless mountains or rivers intervene.

CREAM OF TARTAR.

This salt has of late years been manufactured largely near Messina from the fæces in settlings of new wine. The tartrate of potash, though containing a large quantity of tartaric acid, is too much charged with extraneous and earthy matter, deposited in the fermentation of the must, to allow it to crystalize by rest, on which account it was formerly made up into large balls, dried in the sun, and then burnt in heaps. The tartaric acid destroyed, nothing remained but the potash, which was sold to soap-makers, hatters, and others. This wasteful practice is at length exploded, and at present from fifteen to twenty per cent. of cream of tartar is obtained from the fæces of wine of good quality, while the base, or potash, is employed as heretofore.

SULPHUR.

This mineral is found in most parts of the island; but it is within the area of an irregular diamond, of which Sciacca, Mount Hybla, Alicama, and Terranova are the relative points, that the richest beds are situated. The mines lying within twenty or thirty miles of the coast are at present in full operation. Of those further inward, some are not worked, on account of the high rate of carriage, while others are worked only in discharge of contracted obligations. Generally covered by a bed of calcareous concretion, sulphur is found combined with other matters, its separation from which is effected by burning in kilns, made of gypsum and stone, each containing about sixty hundred weight of mineral. The liquified sulphur escapes through a hole in the front, and runs into a wooden trough, where it is left to grow solid.

CANTHARIDES, OR SPANISH FLIES.

These insects come over from Egypt, and alighting in the olive trees in the months of May and June, are collected by the peasantry and prepared for exportation. They are similar to our curculio, and are caught about Bronte, by jarring the tree over a blanket.

SALT.

The excavation of rock salt, most of which goes to the Danubian pastures, amounts to about one hundred and fifty thousand tons per annum. Evaporating salt is carried on at Trapani and Agosta. At the former place, fifteen hundred and sixty-two tons are annually made.

BEES.

These insects are kept in great quantities in the southeastern districts. Some farmers have from two to three thousand large hives; these are carried, by night, up into the mountains, in summer, and in winter brought to the plains, in both which regions the bees find abundant flowers. Two or three crops of honey and wax are obtained in the course of the year, generally in May and August. The honey of Mount Hybla, near Catania, clear and well-flavored with orange flowers, maintains its ancient reputation.

Owing to the great consumption of wax in churches, the proceeds of bee-hives form a valuable item in husbandry.

DAIRY.

Butter is only made around Messina, Palermo, and in the country of Modria, from the milk of cows and goats. Curds and cheese are made throughout the island, from the milk of cows, sheep, and goats combined.

LIVE STOCK.

Horses.—Those used in riding are in general small, but good; those for draft, wretched and worthless. Their usual fodder is, in the spring, green barley; in summer, a kind of dog grass; in winter, barley, oats, straw, beans, and bran.

The Butera stud, in Sicily, is that of the estate of Radali, held by the Prince of Butera, at Melangianni, near Terranova and Licata. Founded in 1825, at which period the thorough-bred horses and blood mares were imported from England, it increased by degrees, till now it consists of one hundred and six animals. It is placed under the superintendence of an experienced trainer.

Mules are small and feeble, with the exception of the Modua breed, which are tall, strong, and active, and chiefly used for riding and litters. The mules are much employed in land culture and in carrying burdens.

Asses are also inferior, except the Pantelleri breed, which is tall and well made.

Oxen are of two breeds, the red, or Tunis, and the black, or native. The red, which is much used in farming, is large and well proportioned; one species is remarkable for its length of horns, which are often two and a half feet; these are not so strong as those whose horns are more moderate. The black is never put to the plow. In the summer the cattle graze upon the mountains, where they find abundant grass; in the winter they descend to the plains, where they browse on the dwarf palm, the bird weed, and the stubble of corn fields. Unprovided with sheds, they have no other shelter from the weather than the branches of trees, an exposure always prejudicial and often fatal. A cow which is a good milker will yield from four to six quarts per day. Barren cows are usually put to the plow.

Sheep.—The native breeds, white, brown, and black, are small and scraggy, producing a coarse wool, at the rate of from two to three pounds per animal, used for domestic manufacture. The ewes, which are milked regularly, give about half a pint per day. The carcass of a two year old weighs about thirty pounds. The merino breed has been introduced on the Butera estate, which boasts of two flocks of unmixed and crossed, of four and fourteen hundred, respectively.

Goats are numerous; their long and fine hair is woven into cloth and sacking.

Swine compose a gaunt, black breed, remarkable for nothing but the length and stiffness of their dorsal bristles. A one year old hog weighs, if fed on acorns, one hundred and twenty pounds; a two year old, one hundred and eighty pounds.

LAMB AND KID SKINS.

After the month of March the kid and the white and spotted lamb skins are steeped in sea-water, to preserve them from the worms, and to clear them from all fleshy substances. In this state of preparation, which costs about five dollars per thousand, they may be safely shipped, in all seasons of the year, to perform the longest voyages. The black lamb skins are prepared for the German market, at about ten dollars per thousand.

SOIL.

With the exception of the chain of Monte Peloso, or Nestuvo, which runs in a southwest direction from Cape Peloso, and its dependent granitic plains, all the soils of Sicily may be classed under the several varieties of the calcareous. There are, of course, exceptions, but these are so diminutive in comparative extent as not to admit of their being called any more than mere patches. When the soil is deep, which is not unfrequently the case, and this to an extent seldom seen in other countries, it is, for the most part, a rich and fertile loam; where it is shallow, it has the appearance of being sandy and sterile, without being so in reality, as it contains a very great variety of marine exuvia in its composition, derived from the neighboring conchiferous limestone, which yields sufficient humus to enable it to produce the most luxuriant crops, notwithstanding its arid and unpromising appearance.

MANURES.

The usual fertilizing materials are stable manure, and, where it is to be had, that of sheep and goats. Lime, so useful an agent in stiff and clayey soils, which abound in Sicily, as well as in light and sandy ones, also common in certain districts, is totally neglected, to the consequent loss of humidity, which it would absorb from the atmosphere, and the prevalence of vermin, which it would check and destroy. Bones, formerly used for manure, but now employed in chemistry, are become too expensive for the farmer, and are therefore left to be exported, in

large quantities, to France and Genoa. Lupins, as before observed, are in frequent use for manure; their thick, succulent tops, covered by the plow, form a highly fertilizing mass of vegetable matter.

IMPLEMENTS.

The rudest is the plow, which Simond properly describes as an implement which seems to have gained nothing since the days of Tuptolemus. It consists of a shaft, eleven feet long, to which the oxen are fastened by an awkward collar, while the other end is mortised obliquely into another piece of timber, five feet long, with one end sharp, scratching the ground, and the other held by the plowman, who, on account of its shortness, bends almost double while at work. The end in the ground is often, but not always, shod with iron, but it has neither colter nor mold-board. This instrument scarcely penetrates the earth, and is kept straight with great difficulty.

The next is the hoe, which varies in construction in different provinces, according to the nature of the ground. In the vicinity of Palermo, where the soil is not deep, and the heavier soils of the Valle Mazzara prevail, the hoe is broad and shallow; whereas that in use near Messina and the Val Demone, where the soil is light and sandy, is narrow and long, often two feet and more, and sloped in upon the handle. This unwieldy instrument, often containing from eight to ten pounds of iron, is used by the peasants.

The sickle and three-pronged wooden fork offer nothing remarkable.

RENTS.

The usual rent of land for corn, &c., is about one dollar and seventy-five cents per acre, taking the average throughout the island. Leases run for three years, sometimes with the privilege of three more, and occasionally for nine years, but never a longer time. For orange and lemon orchards the rents are higher, and vary widely, according to age and quality. Their standing crop, however, is often sold by the landlord, by estimation, at so much per thousand on the tree, or per thousand gathered by the purchaser, counted on the premises, and often by the heap. When the crop is sold thus, it is at the risk of the purchaser from the day of the contract, and one third of the amount is always paid in advance. The expense of the gathering in all cases devolves on the purchaser.

LABOR.

The laborer by the day receives one tari (eight cents) in money, and in food four and a half pounds of coarse bread, one quart of wine, and one measure of oil for his herb soup. His earnings amount to about twenty cents per day. In some places he is paid entirely in money, in which case he receives about twenty cents per day the year round. In harvest, his wages are generally doubled, and his food given without limitation. The hours of labor from April to harvest are divided

in two portions, from 4, a m., till noon, allowing one hour for breakfast, and from 3, p. m., till sunset. The three hours at noon are for dinner and sleep, a plan which must be attended with the best results, and which we have often vainly endeavored to introduce among our own laborers during the hot season. From harvest to April the hours are from sunrise to sunset, with one hour for dinner and half an hour for breakfast. The price of bread does not vary so much as elsewhere in Europe, and with us being about two cents a pound.

GENERAL CULTURE.

With a population of two millions three hundred and fifty thousand, Sicily has an area of more than six and a half millions of acres, of which 4,000,000 are cultivated with wheat, 1,700,000 are left for grazing, 200,000 are left in woodland, 420,000 are cultivated with grapes, 150,000 are cultivated with olives, 40,000 are cultivated with oranges and lemons, and 30,000 are cultivated with sumac.

The remainder is in other crops and waste lands. The whole is divided into seven hundred thousand properties, the yearly value of each being about twenty dollars. The soil is adapted to all the finest vegetables. Peas are on our table here in February, and I see continually the very finest broccoli and cauliflower. Of the former, there are varieties for each winter month from November to April. Of the latter, a moderate specimen measured more than a foot in diameter. These were under field culture, and not the pet nurslings of a gentleman's gardener, which are often still larger with us; you see everywhere donkey after donkey loaded with them. Lettuce is used for horses, and also the twitch grass, which with us is so formidable an enemy to hoed crops. Walnuts, or Madeira nuts, which with us will scarcely bear in twenty years, produce fruit here in from four to six years. The soil and climate of Sicily are all that could be desired, the working classes seem industrious, and nothing is wanting but enterprise among the men of wealth, and a *laissez faire* practice on the part of the government. The Sicilians of the higher class rarely visit their estates in the country, except for a few weeks, in spring and autumn, when they carry with them all the fashionable follies of the city, and rarely take an interest in agriculture. Notwithstanding the hot weather, by which the country is nearly burnt up in the summer, the peasantry cultivate the land thoroughly, and gather in the crops.

The Neapolitan government is far from being paternal; it is thoroughly repressive of all development. It seems apprehensive lest any of its people should attain wealth, and instead of encouraging an industry which would add to its own revenues, it imposes a burden upon anything becoming too profitable. Large quantities of wheat were at one time grown, and Sicily bade fair to be a great producer of that grain; government then forbade its exportation. They began the extensive production of maccaroni; government forbade its exportation. They produce largely of sumac. Government has forbidden the export of trees, and may next forbid the export of the ground article. Their policy can scarcely be thus to keep it in their own hands, as the plant exists elsewhere. Some enterprising men desired to construct a rail-

road; the stock was all taken, and they were about to commence the work, when government threw obstacles in the way, and the enterprise was abandoned. There is also a tax upon each tree planted, to be paid annually, and not remitted if the tree dies. Whether this is imposed by the government, or by the church, to which two thirds of the island belongs, I could not satisfactorily ascertain; but, however it may be, the result of this wretched policy is that the lessees take no interest in improving the land, and content themselves with a bare subsistence.

One thing is certain, there is no country whatever of its extent that can compare with Sicily in climate, soil, and variety of its products. Were it in the hands of our people, and allowed to develop under our free institutions, its exports would become of unexampled value, and its whole surface would be like a garden.

MADDER.

At Naples we found in the cultivation of madder more peculiarity than we had anticipated, and could readily account for our own failure in its culture on Long Island, some fifteen years ago, when we had no guide beyond the meager information contained in books. It will be borne in mind that the madder root is two feet long, about the size of a large pipe stem, and thus very liable to break in digging from a heavy adhesive clay. The soil should, therefore, be light and very rich, with as much fertilizing matter applied as it will hold. It should be dug or plowed three feet deep, and then laid out in beds or spaces six feet wide, having a vacancy of two feet between them. In these spaces the seed is planted like beet seed, in rows nine inches apart, and covered three inches deep. The quantity of seed required for an acre is one hundred and twenty pounds. The planting is done in March, and the same clearing is required through the season that beets receive. The following November or December, the earth from the two feet vacancies between them is taken out and placed upon the beds, covering them two inches, and sometimes more, as a protection against the cold. In August of the following, or second year, and sometimes of the third year, the roots are dug with a spade two feet long, dried in the sun to one fifth of their green weight, and exported in that condition. They were formerly always ground here, but the adulteration was so great that foreign merchants now prefer to grind it themselves. The average produce of that dug in the second year, or of eighteen months growth, is one ton per acre; that of thirty months growth is one and a half tons per acre. Its value is from one hundred and thirty dollars to one hundred and fifty dollars per ton, and doubtless more in the United States. The quantity grown in the vicinity of Naples is large, but probably not equal to that grown near Avignon.

As a general rule, the quality of all agricultural products is better the further north they are grown, so long as the growth or fruit is not injured by the cold. Thus, the orange is finer in Florida than in Havana, while in Savannah again, it is inferior, as the wood is injured by the above-mentioned cause. Apples, pears, potatoes, wheat, and corn are finer in the northern and western States than in the southern; and although exceptions may exist, this will be found commonly true.

Madder could, doubtless, be most profitably grown with us in the light, rich soils of the south. Whether it can be profitably grown at the north, and its superior quality compensate for the greater trouble, may only be ascertained by actual experiment and a knowledge of the effect upon it of northern winters.

SILK.

We visited the estate of Mr. Strickland, near Naples. This gentleman is much interested in silk culture. He is just finishing a stone cocoonery, one hundred and twenty by thirty feet, and thirty feet high, which is heated by earthen stoves, and will hold the worms from twelve ounces of eggs. He is very particular to throw out all the defective eggs, and consequently no disease has yet appeared among his worms, while it is abundant elsewhere in Naples, and all through Tuscany and Lombardy. The arrangements of his new cocoonery are complete. The frames are made of cane and brown paper, and covered with nets. Upon these nets the leaves are placed, and while the worms are feeding they are lifted off, and the frames cleaned. Mustard is cultivated to give bosquets for the worms to spin upon, the branches being hung above them, and the seed paying the cost of cultivation.

His mulberry trees are planted fifteen feet apart, grafted, and cut down every year, leaving two new branches, each with six eyes. They generally vegetate about the twentieth of March, although a variety called *Filippino* is two weeks earlier. Those known, however, as *Bolognese* and *Majatica* are most generally used. The leaves are ready two weeks after vegetation, and the hatching of the eggs is deferred till they are certain of the right food. The use of substitutes, as in Sicily, might produce disease. The quantity of leaves consumed is about twenty-four hundred pounds to an ounce of eggs, or one hundred and fifty pounds of cocoons. The trees being kept down to the height of seven feet, children can pick the leaves; but this operation is not allowed till the tree has been grafted ten years, when it will produce fifty pounds.

The best worms, and those from which the finest silk is obtained, are called *Pestallini* and *Valdarnesi*, while a coarser kind is made by the *Bolognese*. The hatching is generally about the end of April, but depends somewhat upon the season and the state of the leaf. The cocoons are sold alive at forty cents a pound, and some are always reserved for eggs, which sell for four ducats, or three dollars and twenty cents per ounce. Five hundred pounds of cocoons will produce two hundred ounces of eggs.

The production of silk has been larger in the provinces, but limited in Naples to domestic cultivation among the peasants, who had suffered severely from inferior eggs until Mr. Strickland came, and, by his clean mode and uniform success, induced them to imitate his practice and buy the eggs from him. Whoever may desire a supply, should order not later than the fifteenth of May, as Mr. Strickland only reserves from his sales of cocoons sufficient to meet actual demands. A better source cannot be found, as he is an educated, intelligent man, and an attentive manager, taking great pride in keeping his worms free from the disease which has ravaged Tuscany and Lombardy.

LUPINS.

Mr. Strickland cultivates lupins and plows them in for manure. He thinks them indigestible and unfit for horses, although often cut by others for that purpose when a foot high.

BARLEY.

Two or three crops of barley are grown successively for fodder.

CLOVER.

The Italian clover, in his opinion, deepens the soil.

CASTOR OIL.

Castor oil is grown and manufactured to some extent, but requires much irrigation.

APPLES.

The best apples here are *Limoncelli* and *Melagelata*.

GRAPES.

A grape called Wafrancola is spoken highly of, with a strawberry flavor and coarse leaf, not subject to mildew.

FIGS.

They have a mode of ripening figs ten days earlier by touching the blossom end with sweet oil.

TREES AND PLANTS.

In the botanic garden are *Magnolia soulangiana*, *Pyrus japonica*, and Camellias, in the open ground, all in bloom early in March, with some fine specimens of rare trees, such as *Laurus camphora*, fifty feet; *Araucaria excelsa*, thirty feet; and *Araucaria brasiliensis*, twelve feet; a large tree of *Taxodium mucronatum*, and a fine plant of *Chamærops humilis*. The place appears well kept, under the direction of M. Tenore, but will not compare in richness with the botanic garden at Palermo. There were two trees in the garden of Baron Rothschild which, to a lover of arboreal beauty, would almost be worth a trip from Rome to Naples. They were *Araucaria excelsa;* and those who have admired the small specimens in green-houses can imagine, in some degree, how superb are these, forty feet high, straight as an arrow, full, rich, and feathery, and clothed with a shade of incomparable green.

AGRICULTURE.

The agriculture of the vicinity of Naples presented nothing beside the madder worthy of special attention. The usual proportion of olives and vines grows on its rich volcanic soil. These under a good government would be the source of wealth beyond measure.

ROME.

The agriculture of the Roman Campagna does not offer, like Sicily, numerous objects of interest; and, respecting its leading features, Hillard has written so well and thoroughly that repetition would be needless. One of our most interesting visits was to the estate of Count Herrick. His place is not a large one, but he has for manager a very intelligent Irishman, who has been in Italy some fifteen years, and thoroughly understands the comparative merits of Italian culture. He says that, with all the skill of his countrymen with the spade, they cannot compete with Italians.

VINES.

The soil is about two and a half feet deep, and, to prepare it for vines, the Romans have a mode which they call a *scasscata*. This consists of trenches four feet wide and four feet deep, by means of which the ground is thoroughly broken up and prepared for culture. After the first trench is dug out, the workmen, with a sharp-pointed, strong hoe, undermines the adjacent soil as far as he can reach it, commencing at the bottom and making a lateral trench a foot high; the other three feet soon fall in, breaking up entirely, and thus saving a large part of the labor of digging. For vines, the ground is generally thus prepared to the depth of four feet; still deeper is considered better, and ten feet, if possible, would be desired. When the ground is ready, a cutting five or six feet long is taken, and six or eight inches of its lower end twisted and bent upward, forming an elbow, in which is placed a strong, long-handled, two-pronged fork. Upon the handle is a step for the foot, three and a half feet from the forked end; with this the laborer is enabled to force the cuttings rapidly into the soil, to the depth of three and a half feet, and three feet apart. Thus planted, the cuttings rarely fail to grow, and are preferred to rooted plants, because, with greater facility, they may be planted very deep. There is the same aim in this country, as elsewhere in Europe, to keep the roots of vines as deep as possible; and they are equally careful to cut off all the roots which strike out within a foot of the surface.

CANES.

In the cultivation of the vine here, canes form an important feature, and it would be difficult to find a substitute for them. Four or six are placed around a vine, about a foot from it at the bottom, and meeting

at the top, where they are tied with osiers. They will last two or three years. In many places these canes are used for trellises and fences, and are capable of being applied to so many purposes that their cultivation should be introduced with us. They can be bought here, eight to fifteen feet long, at four dollars per thousand. The soil to grow canes is dug four feet deep, and should be rich. The eyes are planted four feet apart and a foot deep, and the spaces between kept clean; but no hilling up is required, as with corn. A good plantation will produce twelve thousand per acre, for twelve or fifteen years. The heavier the soil, the longer will the plantation continue to produce well.

CLOVER.

Lucerne is cultivated extensively. This is well known to require a very deep soil, and the ground in which it is sown is dug four feet deep. The seed is drilled in, at the rate of ten pounds to an acre. In its best condition, it will bear five cuttings during the season, of three tons per acre, at each cutting. It requires great care in feeding, to avoid injuring the cattle, and is never fed fresh, but cut in the morning and used in the evening. It is thought good for liver disease in horses.

MANURES.

Lupins are used extensively for manure, and are sown after harvest, broadcast, at the rate of three hundred pounds to an acre, costing one cent per pound. They are not covered, but will quickly germinate, growing two feet in three months, at which height they are plowed under. The next best article for this purpose is the French bean. Peas are planted between the rows of vines.

PEACHES.

Peaches are grafted on the almond tree, and are considered better on the sweet than on the bitter. They have no worms at the root, but ants destroy the bark when old.

GENERAL REMARKS.

Manure is not so abundantly used as further north, costing two cents per bushel. The great fertility of the soil and numerous laboring population would, under proper management, make the country around Rome very productive; whereas, under its present metayer system, and want of fostering care, either from proprietors or from government, agriculture is depressed, and there is neither ambition nor effort for improvement.

Some credit, however, should be given to the government for the establishment of a small agricultural school in 1852. There are seven pupils, who pay from their labor, after their education is finished, at the rate of one hundred and fifty dollars per year. There were excellent drawings by the students of flowers, architecture, vegetables, high

and low vine-culture, different modes of farm-culture, and inventions. The course lasts three years, and the ages of the students are from nineteen to thirty. The artistic tendencies of young Romans were here well illustrated, and more rapid progress was never exhibited than by the drawings of these pupils.

FLORENCE.

The finest specimen of landscape-gardening in Italy is the Villa Demidoff, at Florence, and this owes much to the taste of an English gardener, Joseph Goode.

Near the entrance to these grounds there is a mass of rock-work, covered with ferns, mosses, and flowers. A rustic path leads to the top, from which is a view of a miniature lake, filled with fish, and dotted with aquatic plants. The interior of this rock-work forms a grotto, used by the bathers in the lake as a dressing-room. The variegated ivy, which grew in great profusion, produced a pretty effect. There were beyond this some acres of lawns and gardens laid out with taste, and looking very beautiful with the flowers and fresh foliage which thus early in April were in full luxuriance. The purple magnolia, *Spirœ Reveesii*, and Judas tree were in bloom, and masses of *Rhododendron*, *Weigela*, and laurel were very brilliant, the latter filling the whole air with its fragrance. There were large *Paullinias*, *Pittosporum*, and *Arbutus Unedo*. The Banksia roses were in full bloom, and quite astonished us by the great size of the plants. A rose garden, one hundred and fifty feet in diameter, was judiciously planted, with standards and dwarfs, and very pretty seats were formed by roses trained so as to make little alcoves. An island in the middle of a lake was ornamented with a large cage, in which were birds of fine plumage or song, while around it swam several black swans. There was, also, quite a menagerie of the more useful animals, among which we noticed a dromedary and a llama. Each of the animals had a house and large paddock for its especial use. The stables and carriage-houses were in perfect order. The horses were fine, and four black ones, of mixed Norman blood—were showy, and of admirable action. The villa was under repair and could not be seen, but we entered the conservatory through a most charming horticultural library. The glass structures here contain one of the most rare and valuable collections of plants in Europe, among which are an oak leaf, *Grevillea*, fifteen feet high, and a *Metrosideros albicans* twenty feet. An *Agave gracilis*, five feet, was valued at $5,000. *Rhopala corcovadensis* had a very beautiful leaf, like young ferns. *Dicksonia antarctica* was a beatiful fern, four feet high. None of the fern tribe, however, could equal the *Cheilanthes lentigera*, or Brussels lace. Its leaves were finely cut, soft, and feathery, and there was a gracefulness about it quite unequaled in its way. *Lycopodium leptophyllum* was a moss of unusual beauty. But the great charm of this collection was in the variety of plants remarkable for their foliage, among which were some five hundred of *Dracœna nobilis*, scattered all over the house, with their soft luxuriant leaves, tinted crimson, purple, and pink, resembling masses of flowers. There were, also, *Caladium argente*, *Maranta roseolineata*, and many others. These

foliage plants are becoming deservedly popular in Europe. Curious, often brilliant, and growing luxuriantly, they are constantly changing their form, and present always the beauty which belongs to other plants only when in bloom.

There are several other villas about Florence, the grounds of which are found delightful in the early spring, when bright flowers and fresh foliage abound, but they offer no distinctive features worthy of record. One of the best was the *Torrigiana*. In this, masses of blooming flowers, some twelve feet in diameter, in pots, were surrounded by an edging of tile twenty inches high, and produced a good effect. There were an imitation temple of Janus, a high tower and observatory, patches of China roses, hedges of Japan *Euonymus*, weeping *Sophoras*, and an artificial river, with miniature island and stone bridge. A large *Photinia serrulata* was in full bloom, and those who have seen only the shrubby specimens we have in America can scarcely conceive the beauty of a tree fifteen feet high, and the same in diameter, with its glossy, rich leaves, and covered with masses of white fringe like flowers. *Banksia* and Chromatella roses were trained twenty-five feet; and *Souvenir de Malmaison* was grafted on *Banksia*, which, in this climate, makes the best stock possible. There were, also, imitation Gothic ruins, and the unfailing circus of wooden horses—a part of every Italian villa of any pretension. Anemones, tulips, and carnations were in full bloom, and a fine effect was produced by roses trained on fences, in the form of inverted arches. The turf was good at this season, but the summer heat is said soon to destroy it.

Pratolino, about seven miles from Florence, in the mountains, is a place of much beauty, belonging to the grand duke. Here are very few flowers, but delightful, shady walks, miles in extent; fine lawns, openings, and vistas; lakes, cascades, old trees, rose gardens, and well-kept turf. It has, from one point, a superb view of the whole valley of the Arno, with the city of Florence.

The botanical garden at Florence is in good order, and has some fine specimens of trees and shrubs, but is small, and cannot compare with that at Pisa.

One of the specialities of Florence is the Cascina, or farm of the grand duke, through which is a drive, well kept, and flanked by woods and broad meadows, on which some of his best cattle and horses were grazing. For each horse a small stable was erected in the middle of the field.

PISA.

We found time to visit the duke's farm at Pisa, where are kept some two hundred camels. We could not discover, however, that they were of much use, although it is reported that they performed part of the farm work. Those which we saw were quietly lying in their stables, and none could be seen at work about the fields. The farm, which is flat, consisting mostly of woods and pasture grounds, possesses very little interest. There were some fine sheep, and a few cattle, apparently crossed with Durham stock. The cattle of Rome and Tuscany are generally long-horned, large-boned animals, destitute of the beauty

of the English breeds. The best were in the market at Perugia, where there were some beautiful animals, and on the road between Genoa and Pisa, the pet bullocks being driven to town would have been highly prized at any show with us. Count Herrick had a pair of large cows, which did the work of the farm and also supplied him with milk—too much duty for any animals, but evincing their strength and valuable qualities for crossing with other stock. He had a cross between the Roman and Swiss cow, which partook of the best qualities of each. There never can be improvements, however, in cattle, or anything else, where the metayer system prevails. There is, under it, a very thorough cultivation of the land, but no peasant is able to bestow such benefits on his one or two acres as a farmer with us would eagerly introduce.

The country between Pisa and Genoa is well cultivated; wheat prevails, and the vines are trained upon trees, the deep roots of the former and the surface roots of the latter not interfering with each other. Sometimes the center of the tree is cut out, and the other branches trained in the shape of a goblet, with the vine branches interlacing them. The effect is pretty, and every farmer with us could adopt the same plan successfully, by digging a hole, near each apple tree, six feet square and three or four deep, securing good drainage in the bottom, and filling in with rich soil. A Diana or Delaware vine, planted there, would soon cover the whole tree, and give an abundance of fruit.

ARONA.

I searched the surrounding country for the bees desired by the department. I could find nothing which met the description given me, and upon examining the bees of the country carefully, I could discover none different from those with us. Intelligent men, in whose business honey formed an important item, had no knowledge of a bee like that which I described, and I was almost ready to doubt its existence. I made an attempt to get to Milan, to inquire there, but the Austrians had cut off all communication. A similar attempt to reach Turin was frustrated by the closing of the railroad, the advance of troops, and the expectation of an immediate battle. I was obliged, therefore, to defer further search until hostilities should cease.

The charms of Lake Maggiore have been long celebrated, but no description can exaggerate the reality. There is here a mode of training vines which produces a fine effect, namely: upon a sort of trellis, four or five feet high, and then brought over at the top and tied to branches from the next trellis, the point of union being supported by a stake. Every other row of these ties is supported by a shorter stake than its alternate; thus one row forms a gothic, and the next an inverted arch.

From the road, the field presents an undulating surface of green leaves, the top branches completely hiding the trellis. It was thought at one time that the *oidium* was owing to the age of the vines. Many of the old vineyards were therefore destroyed, and new plantations made. The use of sulphur has since proved efficacious, and this destruction useless.

Another charming feature of the cultivation here is, that mulberry and other trees are not disfigured by close pruning, as in Lombardy and southern Italy. They grow with luxuriance, and are kept down by the same degree of pruning that we apply to dwarf pears. Hawthorn hedges and primroses, blooming along the roadside, give the country quite an English look.

Taking a boat, with four sturdy rowers, for the lake had become rough, we visited Pallanza, to obtain some information about bees, and then landed on Isola Madre, one of the Borromean islands. This island is far out in the lake, and beyond the shadow of the mountains. It therefore enjoys an almost tropical climate, and many New Holland plants grow luxuriantly in the open air. There is very little taste displayed in its plan, and many small places in England are, in this respect, vastly its superior. But the combination of agreeable objects is unequaled. You stand in the midst of trees and plants, with us found only in green-houses. From this forest-like luxuriance, the eye passes to the white houses of Pallanza opposite, the strongest possible contrast of the works of Nature and of man. Then the eye wanders over the rippling lake, and, upward, catches the sloping shores, upward still, the crowning hills, covered with foliage, and above all, the highest peaks of the Alps, white and glistening with snow. Here are all the elements of natural beauty—rich vegetation, quiet water, hills, mountains, and snow. Isola Madre contains scarcely more than four or five acres, yet in this small space is an unrivaled collection of trees and plants, and one could ramble about for days, and find each hour some new beauty to admire.

Among the trees which with us require green-house cultivation we noticed a Camelia, thirty feet high, and another of twenty-five feet, with a mass of foliage twenty-five feet in diameter, and covered with flowers; *Acacia dealbata*, fifteen feet high; an oleander, grafted with five sorts, twenty feet high, and twenty-six feet in diameter; a *Rhododendron arboreum*, twenty feet high, in full bloom, incomparably superb; Cactus, on the rocks which bound the shore; Palmetto; *Cycas revoluta;* Carob; Indian fig, in fruit; *Fabiana imbricata; Hakea pugioniformis; Encalypta saligna;* Lemons trained on walls, and in full fruit; large specimens of *Magnolia grandiflora*, some thirty-five feet high; Iris, in bloom; *Escallonia floribunda; Araucaria imbricata;* Ericas, fifteen feet high, in full bloom; masses of Azaleas; *Phillocladus trichomanoides; Cryptomeria*, twenty feet high; Weeping cypress, eighteen feet; *Taxus baccata*, forty feet; *Arbutus Andrachne*, thirty feet; immense *Quercus Ilex; Araucaria brasiliensis*, thirty feet; *Cunninghamia*, eighteen feet; *Euonymus fimbriatus*, six feet; with glossy acuminate leaves; and many other plants and trees too numerous to mention. One of the most striking objects was made by four plants of *Juniperus sabina* forming one evergreen mass, four feet high, and thirty in diameter. Several large *Lagustremias*, twenty-five feet high, are seen a mile distant when in bloom. *Pinus patula*, twenty feet high, with a head twenty feet in diameter, greatly resembled *Pinus excelsa*. A white Banksia rose, with trunk five inches in diameter, showed well the fine effect of this variety.

ISOLA BELLA.

A visit to Isola Bella was productive of less pleasure. It is far more expensive, but constructed with little taste, being a succession of terraces, with too great a predominance of brick and mortar. It reminds one of a fine piece of confectionary. There are, however, many interesting objects; *Cerasus caroliniana*, thirty feet high, and with foliage thirty feet in diameter; groves of oleander, eighteen feet high; Tree Box, thirty feet high; parterres; groves of *Magnolia grandiflora; Metrosideros alba,* twelve feet high, and eighteen in diameter of foliage; *Magnoliaii hartwg,* fifteen feet; *Arbutus unedo,* twenty feet; *Laurus camphora,* forty years old, and some fifty feet high; *Cunninghamia sinensis,* sixty feet; *Cupressus glauca pendula,* twenty feet; and a singular *Abies monocaulis,* forty-six years old, and ten feet high. One of the best things was a grotto, made to resemble the temple of peace, filled with ferns, kept damp by trickling water, and apparently supported by columns of ivy, five feet in diameter, and twenty-six feet long, which grew down from above, and, being detached at the bottom, would swing at a touch from the hand.

The collection in both these islands far surpassed that at the botanic garden of Pisa, and although not so large as that at Palermo, consisted of finer specimens, because less crowded.

The whole country about Lake Maggiore is full of delightful features, and in our pedestrian excursions among the mountains in search of bees there frequently burst upon us scenes of wonderful beauty. The quiet charm of the lake was always present, and we would sometimes walk over stretches of turf like an English lawn, or skirt along copses of underwood, fresh with the peculiar beauty of young vegetation. At one time old trees, with broad arms, would shelter us, and then we would be wandering amid the trained gracefulness of a vineyard, while an occasional mountain torrent, foaming and dashing, would leap across our path.

To visit Italy and not see the Italian Lakes, is to look at a frame and not see the picture. But the nations were gathering to the battle, troops were hastening forward, and, bearing in mind that in war there was lawlessness, we hastened to place the Alps between the combatants and our defenseless party.

FERTILIZERS.

BY HON. THOS. G. CLEMSON, L.L. D.

From the day when the *fiat* went forth, "In the sweat of thy face shalt thou eat bread," agriculture took its place among the arts of the world. It is true, while population was sparse, and man depended first on game and then on flocks and herds, this art made little or no progress. The tropical climate, where the infancy of man seems to have

been cradled, would appear also to have led him to defer the necessity of much attention to it. Very soon, however, the increasing density of population must have necessitated its development, since we find that the Egyptians, at the earliest period to which history reaches, were *already* skillful agriculturists, and had carried the art to such a point of perfection as not only to have sustained their own dense population, but to have made Egypt the granary of the world. That it was not entirely the fertility of that favored region to which this was due, we have evidence in the present state of that country. The Nile still overflows the land with fatness, and the sun still sheds its vivifying influence; yet, there, agriculture has sunk to its lowest ebb, and the country scarce supports its miserable tribes; its immense world-renowned monuments alone remain to show what the land once was. Egypt is the most striking proof which history presents of the inseparable connection between a high state of civilization and a high development of agricultural resources. They rise and fall together, and the prosperity and, indeed, existence of the one is identical with the other. Let that nation beware, whose exhausted fields are forcing her population to emigrate. Civilization, in its highest degree, cannot exist without dense population; nor dense population, without calling to its aid the highest resources of agriculture.

Egypt stands a living, or rather a dead, type of the intimate connection between population and agriculture. China is one equally striking, on the opposite side. For how many thousand years has her pains-taking care for every foot of her soil maintained her prosperous and dense legions, in a region comparatively but little favored by Nature, and given a respectable position among nations to a people but little intellectually gifted! How many wonderful discoveries do we owe to the necessities of their compact masses! The struggle for existence has always been one of the greatest stimulus to the activity of the human mind.

This continuous prosperity, through a long series of centuries, is owing to the sedulous care of the government. No people, left to themselves, will think of future generations; and it is for that reason that all governments should foster and aid the development of this most important of arts, as government only can. This is so well understood in the present day, by all nations, that those who govern are turning their attention daily more and more to its aid and advancement. England has done so by direct legislation; her aristocracy, also an integral part of her government, having, consequently, the weight necessary to carry out a continuous system, has given all the impetus of this weight and their great wealth to its energetic development.

It is only within comparatively few years that science has revealed to us the true composition of bodies and the laws that govern their action; thus developing the wonderful resources of Nature, and reducing that to system which, in the time of our forefathers, was ignorant practice based upon hereditary experience.

It is true that this subject has occupied, from the earliest times, the attention of statesmen, philosophers, and philanthropists; but they only collected and reasoned from the results of experience, without

entering into the laws which led to and governed the results which they recorded. Agriculture, therefore, now stands upon a basis far different from what it has hitherto occupied; and not working, as we have heretofore, in the dark, but knowing *where to look* for causes and effects, we may expect in the next century to make a stride that will give to this art, or rather convocation of arts, a place among the exact sciences. But this very rapidity of advancement will render it more fatal to be left behind in the race; and neither nations nor individuals can stand supinely by, depending upon the past, and exhausting the accumulated resources of Nature, without individual and national ruin. Death is the award of improvidence, to nations as well as to individuals. The continuous march of civilization to the west was the natural result of ignorance; and the civilized world is just beginning to realize the dire consequences that are pending over those who neglect to act upon the unerring laws which science reveals. Sterility and depopulation are consequences not of use, but of abuse. Disappearance of man and all his monuments, even to the entire extinction of vitality, is the consequence of mistaken cupidity, or the ignorance of those laws which govern scientific agriculture. Indeed, that essential art needs no *protection*; we may safely leave to enlightened industry, especially in our country, the application of proper and well-proved rules. That which is necessary, however, is to place within the reach of all the experience of the world, and the important results which science and observation are constantly developing, that time may not be lost in futile and oft-tried experiments. Government, indeed, alone would seem capable of establishing and persisting in a continuous system of improvement and development, not only for this, but future generations. Its influence and weight are essential on the side of advancement.

One of the most interesting and important subjects to the agriculturist is, of course, the means of keeping up, or restoring the fertility of his land; and that he may not work in the dark, it is essential that he should understand the nature and action of soils, the functions of plants, and the operation of fertilizers.

It is important we should always bear in mind that this earth is not a heterogeneous mixture of an indefinite number of illy-defined substances, but, on the contrary, the different objects or forms of matter which present themselves to our senses are limited in the number of their constituents; as far as our knowledge extends they do not exceed sixty-two.

Each substance is *sui generis,* and, no matter from whence taken, possesses precisely similar properties, and is governed by invariable laws in its action upon other substances. They are solid, liquid, or aeriform, according to circumstances. Water is a familiar example; it is solid in the form of ice, liquid in water, and aeriform as steam.

Substances have been created once and forever; they may change place, form, and combinations, but such a thing as blotting out of existence, or re-creation, is impossible. Some are abundant, while others are exceedingly rare, and difficult to procure. To show the small or limited number of substances which enter into the bodies around us, it is only necessary to remember that the great mineral masses, which form by far the largest portion of the earth, are composed, as far as

our knowledge extends, of a few elementary principles. Water is composed of two gases, and the air we breathe likewise of two gases, one of which is common alike to air and water. Nor do they combine in an indefinite manner; they unite with each other in simple, definite proportions, multiples the one of the other, and the quantity rarely surpasses the proportion of five to one. Substances may be, it is true, heterogeneously *mixed* in any proportions, and these mixtures present endless varieties, but are not chemical compounds, and do not enter into the category of which we are speaking.

Matter may be divided into that which has life, and that which is without life. The principal part of the substances which go to compose organic beings exists around us, in the air we breathe, (water, carbonic acid, nitrogen.) There are other substances not less essential to organic life, but which are found to enter their composition in infinitely smaller quantities. These are found in the ashes, after incineration of any vegetable or animal matter. We shall learn their composition as we proceed.

Those things which are endowed with vitality are produced, then increase, and mature. Inorganic substances increase by the juxtaposition of similar parts, and their form is destroyed by forces exterior to themselves, while organisms reproduce their like, and have a period of existence determined by laws, which fix their time of growth, decay, and death. Of organic life there are two distinct classes, one receiving its food through a digestive canal, and is endowed with locomotion; the other is fixed by roots to the soil. This is not rigorously correct, but sufficiently so for our present purpose. The last, or vegetable productions, receive a portion of their food through their roots, and another through their leaves. The root answers a double purpose, that of fixing the plant in the earth, and drawing from it nourishment. Vegetable anatomy informs us that among the elements of their construction there are cells, which are found in all plants, whatever character they may have, and those cells, by transformations and successive development, form fibres, tubes, or elongated canals. While the characteristics of the animal and vegetable classes are thus marked, the qualitative chemical composition of both is identical; the principal organic portions of which—I do not allude to the mineral constituents, or ash, and there is great similarity in that respect—may be said to express the condensation of the gases of which they are composed. Oxygen, hydrogen, carbon, and nitrogen form the volatile portions; and silex, lime, potash, soda, magnesia, iron, sulphur, and phosphorus the mineral parts. It is mainly with those substances that we have to deal in connection with fertility or agriculture. If we can turn a never-ceasing influx of them into our fields, the problem of fertility is solved, and it remains for us to consider their properties, their history, their action the one upon the other, and the means that have heretofore been employed of making them subservient to our wants.

Plants are divided into two distinct classes, those that receive their increment from within and those that receive their growth on the exterior. The first are called endogens, the latter exogens. All organized bodies have forms and properties peculiar and inherent to

themselves, and those forms and properties characterize the parts as well as the whole; and it is that particular form and the properties of the parts that render it what it is and make it a living thing. Some plants go through the different stages of germination, growth, fructification, and death in one season; they are called annuals. Others live through a succession of years, and are called perennial. Some of the minute fungi, on the contrary, go through the stages of their existence in a few hours, and seldom live longer than a few days. Some plants are annuals in a northern latitude, but perennial in a more southern. The oak, the yew, the cypress, and cedar are long-lived trees, and flourish for many centuries. Some remarkable instances of the longevity of trees are noted by historians. A yew tree, which was growing in 1660 in the county of Kent, in England, about which all tradition was lost, measured at that time very nearly sixty feet in circumference at the base, and is believed to have been 2,880 years old. On the island of Nerbuddah, in Hindostan, there is still standing a banyan; the tradition of the natives is that it is 3,000 years old. A species of cypress, which grew near Oaxaca, in Mexico, and which is said to have sheltered the whole army of Cortez, measured nearly 118 feet in circumference, or 37½ feet in diameter, and was computed by Decandolle to have withstood the deluge and been in existence before the creation of man. There is another cypress at Chapultepec, in the same region, which is said to be 117 feet 10 inches round. If the measurement here given be correct, and the tree consists of one stem, we are entitled to consider the Mexican cypress as the most gigantic and ancient tree discovered on the globe.

No infallible rule is known by which we can estimate the age of trees. The known practice of counting the concentric rings in the trunk of a tree, and reckoning each for a year, is liable to error, for a recurrence of cold after warm weather may so check vegetation as to occasion the formation of two layers in one season, or two zones may be fused into one by some temporary injury. But it is nevertheless a close approximation, and may be relied on within certain limits.

It is through the roots that the ash or mineral ingredient enters, while the leaves absorb from the atmosphere the organic or combustible portion. The power of assimilation appears to be dependent upon the action of light. A plant placed in water containing carbonic acid, and exposed to the light of the sun, absorbs the acid and gives off oxygen. At night the action is reversed, and carbonic acid is emitted, when oxygen is assimilated. Every one has remarked the tendency of plants to lean towards the sun, and where they are kept in cellars they will bend even several feet from the perpendicular to receive the rays of light that may enter through an aperture. In the early stages of plant-life, the carbon of the soil enters through the roots; but when the plant has risen above the ground, and its leaves are formed, the carbon of the soil is no longer needed, and it is probable that what is required is entirely assimilated from the carbonic acid of the atmosphere.

The sap rises from the roots through the internal vessels to the leaves, becomes carbonized by the decomposition of the carbonic acid of the

atmosphere, and passes down into the plant, forming ligneous fiber, &c. We shall not enter into the subject of vegetable physiology; that would be foreign to our purpose. Fertility depends at once upon the chemical composition and mechanical condition of the soil; nor can it be independent of subsoil and climatic influences. The latter question, including the chemistry of ozone, is one of great intricacy. It is so interwoven with heat, electricity, moisture, and chemical reaction as almost to baffle investigation. Plants generate and evolve heat, and possess the power of preventing their juices from freezing at a degree of temperature far below that at which congelation would take place were the plant dead. Fertility is a relative term, and is dependent upon multifarious influences. A certain degree of heat and moisture is essential to life; without them, there can be no germination nor maturation of seed; nor are these essentials independent of soil, or rather its constituents, we may say one constituent, for the absence or presence of one substance may secure fertility or produce sterility.

With these preliminary remarks, we pass to the consideration of water in its connection with fertility:

Water in a perfectly pure state is composed of two volumes of hydrogen gas and one of oxygen, and about 89 parts of oxygen and 11 of hydrogen by weight. When you mix the two gases they will remain uncombined for an indefinite period, unless the mixture should be submitted to the action of heat or electricity. The combination then takes place with the manifestation of stupendous force. The two components may be separated by electricity. Water enters into the composition of all vegetable and animal structures. It is one of the principal constituents of blood, milk, and sap. By its assistance, silex and other insoluble substances enter into circulation, and are assimilated by animals and vegetables. It is found to make part of all grains, woods, leaves, &c. Its absence would produce universal death. It enters into all our domestic operations, and forms part of all alcoholic beverages and articles of food. It is essential to production, and it may be said that fertility in any locality is in direct proportion to humidity, and sterility in proportion to its absence. The truth of this proposition is verified in a remarkable degree in the deserts of Sahara and the western plains of this continent.

Water is never obtained pure from natural sources; it is procured by distillation. That which issues from springs, generally contains mineral substances, and always impurities of a gaseous nature. There are waters, even river waters, that at times evaporate without residuum. Such is the case with that of the Schuylkill, at Philadelphia. We have used it for months together, in analysis. Rain-water, and that which falls in the form of dew, are also impure. The former, though much freer from impurities than that which has flowed over the ground, comes down charged with all the impurities of the atmosphere, which it washes as it descends. These substances are varied and numerous, consisting of impalpable sand, vegetable and animal particles, also salt taken up from the ocean. That which first falls after a drought is often charged with the offensive odor of animal perspiration, excrements, and putrefaction. It also brings down fishes and frogs, and at times organisms and pollen, to the extent of tinging the surface of the

earth with the color of the adventitious matter. Rain-water always contains ammonia and nitric acid. These are partly formed by the action of electricity in the atmosphere, and are partly the result of decompositions which take place on the surface of the earth and in the air.

Pure water is insipid and unhealthy. That taken from springs or rivers, independent of any mineral ingredients which it may hold in solution, always contains a quantity of oxygen gas, the great supporter of life and combustion. This imparts a tonic-invigorating quality to cold water, which when boiled it does not possess; to the latter, emetic qualities are attributed. Water, from its known quality of containing oxygen in weak combination or in an evanescent form, together with carbonic acid, is a powerful and essential agent in chemical action, which is ever occurring in the soil, &c. The substances held in solution vary in different rivers and different parts of the same stream, both in kind and in proportions of the saline ingredients. The following analysis of water from different rivers were made by some of the most distinguished chemists of continental Europe, Bouchardat, Boussingault, Dupasquier, Tingry, Grundaub, and Payen:

"For example, 100,000 parts of the water of the Seine above Paris contain 11.3 of carbonate of lime, 0.4 of carbonate of magnesia, 0.5 of silica, 3.6 of gypsum, 0.6 of Epsom salt, 1.0 of chloride of calcium, 0.8 of chloride of magnesium, and traces of nitrates and of organic matter; 100,000 parts of the water of the Marne contain 10.5 of carbonate of lime, 0.9 of carbonate of magnesia, 0.6 of silica, 3.1 of gypsum, 1.2 of Epsom salt, 1.7 of chloride of magnesium, and traces of organic matter; 100,000 parts of the water of the Ourcq, at St. Denis, contain 17.5 of carbonate of lime, 2.0 of carbonate of magnesia, 2.0 of silica, 15.3 of gypsum, 7.0 of Epsom salt, 4.0 of chloride of magnesium, and traces of common salt and of organic matter; 100,000 parts of the water of the Yonne, at Avallon, contain 4.3 of carbonate of lime, 1.9 of silica, traces of gypsum, 1.5 of chloride of calcium, and traces of common salt and organic matter; 100,000 parts of the water of the Benvronne contain 25.7 per cent. of carbonate of lime, 20.3 of gypsum, and 8.5 of chloride of calcium; 100,000 parts of the water of the Thérouenne contain 26.2 of carbonate of lime, 2.0 of gypsum, and 3.6 of chloride of calcium; 100,000 parts of the water of the Gergogne contain 18.0 of carbonate of lime, 1.5 of gypsum, 1.5 of chloride of calcium, and 1.9 of common salt; 100,000 parts of the water of the Bièvre, near Paris, contain 13.6 of carbonate of lime, 25.1 of gypsum, 10.9 of chloride of calcium, and 1.2 of common salt; 100,000 parts of the water of the Arcueil contain 16.9 of carbonate of lime, 16.9 of gypsum, 11.0 of chloride of calcium, and 1.9 of common salt; 100,000 parts of the water of the spring of Roye, at Lyons, contain 23.8 of carbonate of lime, traces of silica, 1.4 of gypsum, 1.2 of common salt, and traces of nitrates and organic matter; 100,000 parts of the water of the Fountain Spring, at Lyons, contain 23.4 of carbonate of lime, traces of silica, 1.7 of gypsum, 1.3 of chloride of calcium, traces of chloride of magnesium, 0.2 of common salt, and traces of organic matter; 100,000 parts of the water of the Rhone, at Lyons, in July, contain 10.0 of carbonate of lime, traces of silica, 0.6 of gyp-

sum, and traces of Epsom salt, of chloride of calcium, of chloride of magnesium, of common salt, and of organic matter; 100,000 parts of the water of the Rhone, at Lyons, in February, contain 15.0 of carbonate of lime, 2.0 of gypsum, 0.7 of Epsom salt, 0.7 of chloride of calcium, and traces of nitrate of lime and of organic matter; 100,000 parts of the water of the spring of the Garden of Plants, at Lyons, contain 27.0 of carbonate of lime, 25.2 of gypsum, 16.8 of carbonate of calcium, 1.6 of chloride of magnesium, 12.6 of common salt, 7.6 of nitrates, and traces of organic matter; 100,000 parts of the water of the Lake of Geneva contain 7.2 of carbonate of lime, 0.7 of carbonate of magnesia, 0.1 of silica, 2.6 of gypsum, 3.1 of Epsom salt, 0.9 of chloride of magnesium, and 0.6 of organic matter; 100,000 parts of the water of the Arve, in August, contain 5.2 of carbonate of lime, 0.4 of carbonate of magnesia, 0.1 of silica, 3.2 of gypsum, 2.9 of Epsom salt, 0.7 of chloride of magnesium, and 0.3 of organic matter; 100,000 parts of the water of the Arve, in February, contain 8.3 of carbonate of lime, 1.2 of carbonate of magnesia, 0.2 of silica, 6.5 of gypsum, 6.2 of Epsom salt, 1.5 of chloride of magnesium, and 0.4 of organic matter; 100,000 parts of the water of the Loire, near Orleans, contain 1.7 of carbonate of lime, 5.1 of chloride of calcium, and traces of common salt; 100,000 parts of the water of the Loiret contain 11.9 of carbonate of lime, 3.8 of gypsum, 10.2 of chloride of calcium, and 2.5 of common salt; and 100,000 parts of the water of the artesian well at Grenelle, near Paris, contain 6.8 of carbonate of lime, 1.42 of carbonate of magnesia, 2.90 of bicarbonate of potash, 1.2 of sulphate of potash, 1.09 of chloride of potassium, 0.57 of silica, and 0.24 of nitrogenous organic matter."

It will be borne in mind that the above-named substances are in solution and do not include those held in mechanical suspension. The waters analyzed above are not only limpid, but such as are used for the kitchen and all the daily purposes of life.

Much has been written upon the sewerage of cities throughout the world. This is a subject of great importance, not only to the agricultural wealth of the country, but imminent to its sanitary condition. The value that is daily washed into rivulets from our lands, and thence to the sea, is incalculable. Mr. Grey, in speaking of the Medloch, says: "it receives the drainage of not more than 100,000, and contains sufficient phosphoric acid to supply 95,000 acres of wheat, 184,000 acres of potatoes, or 280,000 acres of oats, and to hold in solution a sufficient quantity of silica to supply 50,000 acres of wheat."

A distinguished agricultural writer in 1845 makes the following remarks upon the subject of the sewerage of London:

"By carefully conducted experiments and very accurate gaugings it has been found that the chief London sewers convey daily into the Thames about 115,000 tons of mixed drainage, consisting on an average computation of one part of solid and twenty-five absolutely fluid matters; but if we only allow one part in thirty of this immense mass to be composed of solid substances, then we have the large quantity of more than 3,800 of solid manure daily poured into the river from London alone, consisting principally of excrements, soot, and the debris of the London streets, which is chiefly carbonate of lime; thus, allowing twenty tons

of the manure as a dressing for an acre of ground, there is evidently a quantity of solid manure annually poured into the river equal to fertilizing more than 50,000 acres of the poorest cultivated land! The quantity of food thus lost to the country by this heedless waste of manure is enormous; for only allowing one crop of wheat to be raised on these 50,000 acres that would be equal to the maintenance (calculating upon an average produce of three quarters of wheat per acre) of 150,000 persons. London, too, is only one huge instance of this thoughtless waste of the agricultural riches of the soil of England. From every other English city, every town, every hamlet, is hourly passing into the sea a proportionate waste of liquid manure; and I have only spoken of the solid or mechanically suspended matters of the average; the absolutely fluid portion is still rich in urine, ammoniacal salts, soda, &c."

The earth is surrounded by water in a state of vapor, and the quantity varies according to the temperature of the atmosphere and other circumstances. Verner found as a mean of fifty experiments, in 1,000 parts of air, 8.47 parts of vapor. In the forenoon, and before two o'clock, the mean was 7.97; and between two p. m. and evening, 8.85. There is more humidity in the atmosphere during the day than at night; and more during the summer than winter; more in low flat countries than in mountainous regions; and less in the interior of continents far removed from rivers, lakes, or the ocean. A slight change in the temperature of an atmosphere, saturated with humidity, produces fogs, clouds, and rains; and by congelation, snow, &c. A continuous evaporation takes place from the ocean, lakes, rivers, and the soil, and a return to the earth in form of dew and rain. The amount of evaporation that takes place in a country is greatly influenced by the operations of the farmer. In a report made by Andrew Brown and Dr. M. W. Dickeson to the American Association, in 1849, those gentlemen remark "that the annual quantity of rain that falls in the valley of the Mississippi may be estimated at 169,128,960,000,000 cubic feet, which is about $11\frac{3}{8}$, or 11.3636, times the quantity which is discharged by the river. There can be but two ways by which this immense quantity of water can make its escape from the valley; one is by the course of the river, and the other by evaporation; $\frac{8}{91}$ parts are carried off by the river and $\frac{83}{91}$ parts by evaporation. Thus, we arrive at a fact of the most momentous importance to the planting interests of Louisiana and Mississippi; for it will be at once perceived that the more exhalations are promoted, the less liable will the low or bottom lands of these two States be to the periodical inundations by the river.

"If it be asked by what process it is expected that evaporation can be promoted over such an extensive area as the Mississippi valley, so as visibly and permanently to affect the planting interests of the above-named States; the answer will be found in the fact that the process has been, and is now, in the most rapid and successful progress, and of that kind which is the best calculated to produce so desirable a result, viz: the clearing of such large portions of the valley of its forests for the promotion of agriculture, and the consequent exposure of the lands to the action of the sun and winds, the very best promotors of the evaporating process, particularly on a large scale.

"So rapid is the progress of this increased exposure and its consequent evaporating tendency, and so visible have been its effects on the Mississippi river, that we may hazard the assertion with safety, that there is not now by twenty-five per cent. as much water passing down the Mississippi as there was twenty-five years ago; for at and prior to that time, there were annual inundations of many feet, and long periods of submergence of almost all the bottom lands, from the bluffs on one side of the river bottom to those on the other side. Such lands were at that period accounted valueless, and to such a degree that but little or no hopes were entertained of the practicability of their redemption by any artificial means—that is on any general scale; but such has been the diminution in the annual quantity of water discharged from the valley, that those lands have been progressively and rapidly redeemed from overflow, until very great portions of them are now in the highest state of cultivation, and with but slight assistance from art in the way of embankments, and these such as could not have been at all available against the overwhelming effects of floods and the length of time of their continuance; for then there were annual inundations, both deep and expansive, of the waters, over almost all the bottom lands, but now the river seldom rises to the same elevation as formerly, and, when it does, it is of much shorter duration, and the waters are almost exclusively confined to the channel of the river, in place of being spread over almost all the bottom lands the whole spring and early part of the summer."

Such changes are progressing, generally unsuspected and overlooked, but not the less sure.

The art of producing large crops by means of artificial supplies of water, has been practised from remote ages in the warm countries of the world. It was used by the aborigines of America, by the Incas, the inhabitants of Mexico, extensively practised by the Egyptians, the Romans, and at the present day in France and Germany. The Hindoos make no attempt at cultivation without artificial irrigation. The rivers of Italy are made subservient to agricultural wants wherever it is practicable. Arthur Young gives an account of an hour's run of water through a gutter, near Turin, which produced, in 1778, 1,500 livres. The rent of irrigated lands in Italy is much larger than upon land not watered. Moses, in speaking to the Israelites in the wilderness, said: "The land whither thou goest in to possess it, is not as the land of Egypt, whence ye came out, where thou sowedst thy seed, and wateredst with thy foot, as a garden of herbs." Here the lawgiver alludes to the machines that were used in Egypt, which they worked with their feet, for raising water. Virgil tells how to bring down the waters of a rivulet upon the sown corn, and when suffering from heat, to convey the vivifying liquid from the crown of the declivity, in channels, to the roots of the plants. Columella, Pliny, Cato, Varro,* &c., all dwell upon the importance of irrigation. It is found profitable in England to irrigate plantations of willows and other semi-aquatic trees upon dry soils. The efficiency of irrigation is

* Sine aqua omnis agricultura est miserabilis et sine effectu.—*Varro, d. r. r.*

dependent upon many considerations; one of the principal is the nature of the subsoil. When it is a tenacious clay, the preparation consists in suitable under-draining, that would be useless where the subsoil is sand or open gravel.

Some waters are injurious. Certain salts of iron are known to be unfavorable to vegetation. Waters issuing from factories impregnated with animal and vegetable substances, such as the waters of distilleries, breweries, slaughter-houses, &c., are highly fertilizing; others issuing from chemical establishments, calico printing factories, are injurious. Salt water in small quantities may be found useful upon certain plants, such as the grasses, asparagus, &c., while they are positively injurious to such plants as rice. The salt marshes of France are known to produce a superior quality of mutton, which commands a high price, and is known in the French market under the name of "pres salé."

Waters impregnated with carbonate and sulphate of lime are very fertilizing. In certain parts of Germany, a weak solution of sulphuric acid has been employed for irrigating grass lands with great advantage. Those which hold in suspension mud and other detritus, are highly useful, particularly on sandy soils; the fine mud settles in the pores, and gives consistency, but any soil would be benefited by water holding mud in suspension, and that, of course, in proportion to the amount of organic and saline matter in the mud.

Sir Humphrey Davy thought that the protection of grasses from frost during the winter season was of great importance, for a meadow irrigated in winter is preserved from sudden alternations, and from the effect of the roots being thrown out of the ground by alternate freezings and thawings. The water immediately in contact with the roots of the grass is rarely below 40° Fahrenheit. In the month of March, in a meadow near Hungerford, the air was, at 7 o'clock, A. M., at 29°. The water was frozen above the grass, and the temperature of the soil below the water in which the roots were growing was 43°. While the temperature is thus prevented from falling during the winter, it is kept cool during the summer.

Irrigation supposes water in motion; if it be allowed to stand and stagnate, its effects would destroy the objects sought to be accomplished. Instead of fine grasses we would have a growth of carices, junci, and other coarse plants of no value.

Sir John Sinclair says that the advantages of meadow irrigation are chiefly as follows:

First. With the exception of warping, it is by far the easiest, cheapest, and most certain mode of improving poor land, particularly if it is of a dry and gravelly nature.

Second. Land once improved by irrigation, is put into a state of perpetual fertility, without any occasion for manure or trouble of weeding or any other material expense.

Third. It becomes so productive as to yield the largest bulk of hay, beside abundance of the very best support for ewes and lambs in the spring, and for cows and other cattle in the autumn of every year.

Fourth. In favorable situations, it produces very early grass in the spring, when it is doubly valuable.

Fifth. Not only is the land thus rendered fertile without having any occasion for manure, but it produces food for animals, which is con-

verted into manure, to be used on other lands, thus augmenting, in a compound proportion, that great source of fertility.

The subject of irrigation is one of immense importance, in a dry, arid climate, such as characterizes portions of the western plains particularly. It is paramount, and may be employed throughout the continent with advantages greater than any other agricultural application. It is an important art of itself, and one that requires special acquirements for its adaptation.*

The direct action of the fertilizing constituents of water are not the only influences which that substance exerts upon our fields and growing crops. Its simple percolation through a soil has an important influence, by displacing gases and thus creating circulation of air and bringing a fresh supply of ameliorating agents.

A little reflection will teach us how to prevent the disastrous consequences of the sudden and powerful rains that fall in our climate. If the ground is cultivated shallow, we must suffer from washing. A hill-side plowed two or three inches would meet with the same fate that we would expect if we were to expose an inclined looking-glass, upon which we had sprinkled sand. The deeper a soil is stirred the better rain will be absorbed, instead of running off; and the deeper the furrow the longer will the moisture be retained. The alternate influence of showers and sunshine upon deeply-stirred land brings about another important effect, which cannot be obtained without it: we allude to aeration, an influence of great importance, by which not only the organic portions of the soil are, by aid of air circulation, brought into a state of decomposition; gases are evolved, new combinations formed, the inert mineral constituents are also decomposed, new salts are created, and numerous chemical actions take place, producing active food for plant-life.

It is, of course, necessary to distinguish between a wholesome humidity and destructive saturation; while the one is to be cherished, the other must be avoided. On the subject of under-draining we shall not enter; its importance is too great for a cursory notice in a paper of this kind, and we refer our readers to the many valuable publications written upon the subject.

Liebig makes the following beautiful remarks:

"There is not to be found in chemistry a more wonderful phenomenon, and which more confounds all human wisdom, than is presented by the soil of a garden or field.

"By the simplest experiment, any one may satisfy himself that rain-water, filtered through field or garden soil, does not dissolve out a trace of potash, ammonia, silicic, or phosphoric acid. The soil does not give up to the water one particle of the food of plants which it contains. The most continuous rain cannot remove from the field, except mechanically, any of the constituent elements of its fertility. The soil not only retains firmly all the food of plants which is actually in it, but its power to preserve all that may be useful to them extends much further. If rain, or rather water, holding in solution ammonia,

*See Stephens's Practical Irrigator, Smith's Observations on Irrigation, Brown's Treatise on Irrigation, Sir John Sinclair's Code of Agriculture, Voyage en Espagne, par M. Jaubert de Passa, Anleitung zum praktischen Ackerbau von Schwerz, Lr 1

potash, phosphoric, and silicic acids, be brought in contact with the soil, these substances disappear almost immediately from the solution. The soil withdraws them from the water. Only such substances are completely withdrawn by the soil as are indispensable articles of food for plants. All others remain wholly or in part in solution."

In connection with this interesting subject, it may be remarked that the absorbent power of soils varies according to their composition. It is greater in clays than those which are silicious or sandy, but belongs to all, more or less, not excepting those of a calcareous nature. Liebig tells us that if the phosphate of lime be dissolved in weak carbonic acid water, and the solution filtered through a soil, the phosphate of lime is removed from solution, and the same result takes place with the phosphate of magnesia and ammonia. This is a fact of great agricultural importance, from the constant occurrence of those substances in organic manures.

The complete absorption of potash, ammonia, and phosphoric acid by the soil, and thus entering into combination and forming insoluble compounds, would appear to militate against the received opinion, viz: that plant food must necessarily be in a soluble state for assimilation. This is contradicted by the above facts. It is, besides, well known that plant vitality has the power, as it were, of corroding insoluble substances, and absorbing them by the roots. Varieties of plants growing upon rocks contain large quantities of the substance of which the rock is composed. Such is known to be the case with lichens growing on calcareous rocks. Again, the roots of the grape-vine have been found surrounding, and its rootlets insinuated in every manner through, around, and enveloping a piece of bone, which finally disappears. Nor does it seem that assimilable food should necessarily be soluble, provided it be in a state of atomic division.

It has been stated that the constituents of plants are divided into two classes, organic and inorganic. The first named are derived from water, carbonic acid, nitric acid, and ammonia, and may come from the air through the leaves, or from the soil through the roots. The inorganic constituents are of a different character, and can only be received from the soil and through the roots. It then becomes important that there should be deep preparation of the soil, in order to commingle the surface with that which underlies, that the roots in their search for food (for it is proved that it does not circulate in the soil as it becomes fixed by combination) may more readily come in contact with all the substances the plant requires to form the wonderful compound necessary to its growth and development. Deep preparation insures aeration, and the decomposition of the constituents of the soil is thus attained by the action of the atmospheric agents. Both carbonic and nitric acid, which are known to exist in the air and water, have a powerful action upon the soil, but unfortunately our knowledge upon that subject leaves much to be desired. The importance of minute division of the soil, and the manures which may be added, must, on reflection, be evident to every one. Plants assimilate food in a state of atomic division, and the nearer we approach that point the better; beside which, they will more readily undergo those chemical changes which are ever taking place in Nature's great laboratory, the earth.

By breaking the clods mechanically, by exposure to the air, and the freezing effects of water, the mass is pulverized, and thus food, before locked up, is approached and used by the tender roots of the plant.

"Plants cannot obtain from the soil more food than it contains. Further, its fertility is not to be measured by the whole quantity present in it, but only by that portion of the whole quantity which exists in the smallest particles of soil, for it is with such portions alone that the rootlets can come into close contact.

"A piece of bone weighing one ounce, in a cubic foot of earth, produces no marked effect on its fertility. But if this one ounce of phosphate of lime be uniformly distributed throughout the earth, it will suffice for the nourishment of one hundred and twenty wheat plants.

"Of two fields with the same amount of food, one may be very fertile, and the other very unfruitful, if the food is more uniformly distributed throughout the former than the latter. The common plow breaks and turns up the soil without mixing it. It only displaces, to a certain extent, the spots on which plants have already grown, but the spade breaks, turns, and mixes it thoroughly."*

Those plants which reach maturity in a short time are materially affected by the preparation of the soil. Their powers of absorption are much greater in the spring than in the summer, when the leaves are being formed, and when the plant is in the full vigor of growth, than when it has reached its maturity. We have a familiar instance of the importance of preparation in our corn crop, and the stimulus that is imparted to it by constant working, by which food is continually renewed and brought into close contact with the roots, and the soil kept in a well pulverized state, thus increasing its absorbing powers. The descent of water through the soil, and its escape upward as vapor, tend to the same end, and hence the great importance of under-draining.

Chemists employ sulphuric acid in their experiments for absorbing moisture. Lime and caustic potash are also used. Soils possess the absorbent power in an eminent degree, and it is by that inherent quality that plants are enabled to resist extreme droughts. The power of absorption depends greatly upon division, color, &c. A dark soil absorbs heat more readily than a light-colored one; it also radiates heat quicker. When the sun sets, the earth begins to radiate; in proportion as it cools, will be the amount of dew deposited. When a gas passes to a liquid state, caloric is evolved; such is also the effect when a liquid passes to a solid. The reverse occurs when a solid becomes liquid, or a liquid a gas. By the condensation of vapor, or the formation of dew, heat is evolved; by the absorption of dew, a further degree of sensible heat is produced. This process prevents a too sudden change of temperature in the surface of the earth, and which otherwise would have been sensibly affected by the too great radiation of heat. This equalization is brought about in a manner to excite our admiration. Evaporation is far more rapid in a dry, than in a moist, atmosphere, and more rapid in a current of air than when it is still or stagnant. Dry, porous, and thoroughly-pulverized soils radiate heat

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* Liebig's Letters on Modern Agriculture, p. 108.

from a vastly greater number of points than wet and compact soils, and receive more abundant depositions of dew. Sands are powerful absorbents, and some countries depend almost wholly upon this for the support of vegetation. The sandy plains of Chili seldom receive any rain, yet, in consequence of their excessive radiation of heat and the heavy dews at night, they maintain a high fertility. If a soil be sufficiently permeable to the air, condensation may take place below during the day, at the same time that the surface may be giving off both heat and moisture, which is due to the relative degree of heat between the two.

To the farmer and the gardener, the soil is that portion of the earth's surface or crust which supports vegetation, or that is susceptible of cultivation, and is rich or poor accordingly as it is well or illy adapted to production. Soils are formed from the decomposition and disintegration of rocks, and are either from those immediately underlying, or may have been brought from a distance by causes still acting, or that have ceased to operate. The tendency of all high land to depression, and the consequent elevation of low grounds, is a never ceasing action upon the surface of the earth; winds and tides, currents and volcanic perturbations, elevations, the depressions and ejectments, continuous action of the atmospheric agents, changes of temperature, moisture, &c., and those causes acting from eternity, have caused the present state of the surface of the earth. But the soil contains more or less of plant and animal life, or the result of their decomposition. Traces of obscure microscopic life first manifest themselves; these objects live, assimilate food, procreate, and die. From their remains other and a higher order of organisms appear; they run their course and disappear, and their substance is by gradation finally transformed into the bone and muscle of man.

The soil has a varied composition, according to locality and circumstance. The decomposition or disintegration of an argillaceous rock would naturally give rise to a soil in which aluminous properties would preponderate. If the soil originated from a silicious rock, then it would be sandy; if from limestone, we should expect it to be calcareous. These and other substances, variously intermixed with organic matters in different states and stages of decomposition, form soils. They owe their properties to the distinctive minerals from which they are derived.

These inorganic constituents do not exist in the atmosphere, and are supplied by the earth, as they do not grow; and having been created once and forever, it follows that, if removed, they must be replaced. It does not matter how removed, whether in the form of grass, grain, milk, flesh, or bone, if taken away they are gone, so far as the farmer is concerned. This principle lies at the foundation of all successful agriculture, and is the fundamental axiom for which Liebig and others have so long, so laboriously, and ably contended.

It would be as ridiculous for the miner to suppose that his exhausted placer would yield as much gold by re-working, as for the farmer to think that his exhausted lands would be recuperated without the addition of the substances extracted from it.

All the constituents of soil are compounds: they are oxydes of some

metallic base, the organic portions are animal and vegetable substances in a decomposing state, complex and passing by degrees to simple forms. Soils, then, in complexion and composition vary. Two soils originating from the same rock may differ widely, in consequence of mechanical condition, subsoil, situation, climate, and cultivation. But as rocks are the same in all parts of the world, so must they give rise to a similarity of soil. In one hundred and forty-six soils analyzed by the geological surveyor of Massachusetts, taken from every variety of rock formation, the most remarkable uniformity was presented. These again, as compared with forty-eight soils from Germany, Holland, Belgium, Hungary, and Bohemia, offer the same striking uniformity, differing but slightly from American soils.* These facts would appear to show that there is not only a great similarity, but that their composition is independent of the variety of rocks which they overlie. Some of the most fertile are those formed by deposits, and the amount of fertilizing material carried from one spot to another, or entirely lost in the ocean, defies any estimate. Drs. Dickeson and Brown estimate the annual deposit from the Mississippi river to amount to the enormous quantity of 28,188,053,892$\frac{1}{6}$ cubic feet of solid matter. That amount is independent of the coarse sand and gravel transported by the river current, which they were unable to estimate.

Mr. Leonard Horner estimates that "the Rhine carries down every year 1,973,433 cubic yards of earth, and if this process has been going on at the same rate for the last two thousand years, and there is no evidence that the river has undergone any material change during that period, then the Rhine must in that time have carried down materials sufficient to form a stratum of stone a yard thick, extending over an area more than thirty-six miles square."

From the nature of the constituents of silt, and the finely comminuted state in which it is deposited, we should expect it to be fertile; and so long as the deposits continue, so long will their richness remain. Such soils are among the richest known. The low grounds bordering on the Nile, the Mississippi, the Rhone, the Danube, the Po, the Wolga, Orinoco, &c., are examples, and maintain their fertility without apparent diminution. The composition of alluvium depends upon the geological formations and the character of the country through which the waters pass; and the nature of the deposit again depends upon the current. If the stream be sluggish, the particles are much finer than if the water be rapid or turbulent. When the uplands of our country have been impoverished by successive croppings or injudicious tillage, the low grounds will resist longer, and continue to be a resource. But the amount of low ground is insufficient to supply the requirements of a dense population; hence the necessity of fertilizers. Organic manures, those of a nitrogenous nature, have been used from time immemorial. It is said "that the barn-yard yields a panacea for all the farmer's ills." This is not rigorously correct; for there are soils which never can be rendered fertile by the application of barn-yard manure, but which may be improved by correctives, and the addition of organic substances.

* Dana's Muck Manual.

LIME.

Next to manure, the most common fertilizer used throughout the United States, wherever it can be procured, is lime, either burnt from limestone or oyster shells, or in the state of a sulphate commonly called gypsum or plaster of Paris. It appears to have been used from remote antiquity, and there are few soils which are not benefited by its application. It does not seem to be of very great importance whether it be added to the soil in the shape of lime direct from the kiln, slaked, or in the form of carbonate, as it occurs in chalk, marble, or marl. The essential point is extreme fineness. The finer it is, the more easily it enters into combination and produces its effect. This purpose is always better attained by burnt lime, whatever it may be burnt from, whether limestone, marble, or shells. Lime has a great affinity for carbonic acid, which is one of the ever-present constituents of the atmosphere; so that, upon the exposure of caustic lime, it soon becomes carbonated. Caustic, or fresh-burned lime, when put in contact with organic matter, either animal or vegetable, causes immediate action and rapid decomposition. Carbonate of lime is less active; and, although it has lost its caustic power by the absorption of carbonic acid, still it produces important changes in soils. As we have seen, soils are mixtures of salts and organic matter, containing air and water in their pores. Here lime acts, decomposing the organic matter, and freeing carbonic acid. It again acts upon the alkaline and earthy salts, decomposing them, and enabling them to form such combinations as the plants require.

Chemistry has rendered important services to agriculture in many ways; none more than by analysis of soils; not by informing us of the difference between poor and rich soils, nor by pointing out the specific wants of the farmer, or the particular applications to each soil so hoped for by him; but by showing us that certain combinations exist in the soil; that a simple silicate of alumina is barren, experience proving that the mere application of manure to it will not give fertility; though, lime being added on common clay, a double silicate of alumina and lime will be found, which, in the course of time, with manure, becomes fertile. Lime added to a clay soil destroys that sticky, waxen consistence that makes it so difficult to work, and prevents the baking and hardening so fatal to vegetable life. The addition of lime is not so beneficial from its mere presence in a soil, for generally there is enough for plant food; but its good effect is chiefly owing to the chemical changes it causes among the substances forming and existing in the soil.

It has been long known that a mixture of lime, earth, and rich organic matter, such as manure and decomposing vegetable substances, causes the production of nitric acid. Such a mixture is used in many parts of the world to produce saltpeter, which is a nitrate of potash. It is collected from the earthy mixture by dissolving it in water, which is evaporated, leaving the salt in crystals. The same thing takes place in the earth; when lime is added to it, nitric acid is formed, which combines with the alkalies and earths in the soil, forming nitrates. These are all excellent fertilizers.

The exact manner in which lime acts upon the soil is not entirely understood, but that it does produce a wonderful effect, and a very beneficial one, is well known. The limestone formations in the United States are of very great extent. Our best wheat soils overlie them. By analysis, we find no carbonate of lime in these limestone clays; yet it does not follow that lime is not there in some shape. Accordingly we discover it in the state of phosphate and silicate. Upon these limestone soils lime has been largely applied, and the result has been excellent. We owe much to Mr. Edward Ruffin, of Virginia, for his practical application of lime, and for his publications in regard to it. By his efforts in this respect a revolution has been created in agriculture throughout the tide-water regions of Virginia.

Some of the soils in the United States, overlying limestone rocks, contain carbonate of lime, while others are formed of a decomposing limestone, or, as it is called in Alabama, "rotten limestone." Here, of course, we have lime largely in the soil. This is not the case with soils overlying the blue limestone of New York, Pennsylvania, Maryland, and Virginia. The composition of these soils shows a different origin. The numerous and large springs throughout this region form a great source to the soil of carbonate of lime. This is insoluble; but the bi-carbonate, in which the lime has a double quantity of carbonic acid, is soluble and easily gives off a part of its carbonic acid, returning to a carbonate, and to an insoluble state. The springs bring up the lime in solution, in a state of bi-carbonate, which, upon exposure to the atmosphere, loses a portion of its carbonic acid, and is deposited in the earth in the shape of limestone. The most familiar example of this occurs in a tea-kettle, which soon becomes incrusted with limestone, if limestone water be used in it, from the cause we have mentioned above.

By far the largest portion of the soils east of the Alleghany and Blue Ridge are formed from the older and crystaline rocks, and consequently contain less lime than soils of a different origin, there being neither limestone nor springs from limestone rocks to impart it to them. All these soils, without exception, would be benefited by the application of lime. When using the word lime, we would not wish to be understood as meaning the result of burnt limestone or shells only, but in whatever shape it may be found, as marls, &c. Lime, added in small quantities annually, would seem, from experience, to have a better effect than when put on the land heavily at once. It is stated, on reliable authority, that so small an amount as a bushel to the acre has produced good effect. In some parts of the country it is customary to add burnt lime in great quantities, as high as two hundred and more bushels per acre. Utter sterility for sometime has been the result of such profusion. Prudence and economy would suggest smaller supplies. Some care should be used in selecting the limestone from which to make lime, as it is seldom pure, often containing large portions of magnesia and sand, and always more or less phosphate of lime. The magnesia, if not in too large quantities, can hardly be objectionable. The phosphate of lime is very desirable, and too much of it can scarcely be applied. The sand in limestone might be objectionable on the score of economy, otherwise its use on a stiff clay would be beneficial. Oys-

ter shells might naturally be expected to contain phosphate of lime in considerable quantity, and these are, perhaps, the best materials from which to make lime for the farm.

It must be borne in mind that lime of itself will not give fertility to soil. The materials upon which it can act must be present, or its greatest effect will be lost. There must be organic matter in the soil, either as decomposing manure or as vegetable mold, upon which it can operate. Lime brings into play the constituents of the soil, and enables the plant to feed on them, while, as a salt, it forms the food of plants, yet its great effect is upon the different parts of the soil itself. The richer this may be, the better will prove the effect of lime; the poorer the soil, the slower and worse the effect. It is owing to this cause that lime has been condemned in many cases, it having been put upon poor soils, where there was nothing for it to operate upon. The effect of lime, it will be observed from what we have said above, is long continued. Its benefits can be seen for crop after crop. As long as there is organic matter in the soil, it slowly decomposes it, forming new combinations and fresh food. Those results which we produce in the laboratory, fall far short of the endless changes going on in the earth. He who undertakes to explain every operation of Nature will fail most lamentably. There are causes at work we but little understand. Who can explain vitality? It has much to do with the marvelous actions and reactions going on in the earth. By it inert matter becomes part of life, fills its functions, decays, forms new life, and thus runs on in an eternal round.

MARL.

Next to lime, marl has the most extensive use, as a fertilizer, in the eastern part of the United States. It has been found from New York, along the coast, to the Gulf of Mexico. We have heard of none between the Rocky and Alleghany mountains, unless it might be on the Gulf of Mexico. The composition of marls is various, most of them abounding in carbonate of lime. To this they owe a great cause of their usefulness. The word marl has various significations in the United States. In New Jersey, the green sand is called marl, while on the Chesapeake the calcareous earth, so largely used there, bears the same name. In Europe, the word marl would appear to be applied to substances as often without lime as with it, and not by any means confined to a class of calcareous earths. The application of marl, or a variety of substances under that name, is of quite ancient date. Marling was practised by the Greeks and the Romans, and Pliny, in his Natural History, evidently alludes to and mentions chalk, under the head of marl. He says the Gauls and Britons sunk shafts to the depth of a hundred feet for the extraction of white chalk. It was used to scour silver, and is the whiting of the present day. The same substance, on being put on land, produces fertilizing effects for eighty years. In England and on the continent, chalking and marling are synonymous terms; and it is probable that substances of an unctuous, soapy feeling came into use because they were supposed to possess properties similar to chalk.

The pure green sand marl of New Jersey, according to the analysis of Mr. Henry Seybert, contains no lime. He obtained as follows:

Silica	49.83
Alumina	6.00
Magnesia	1.83
Potassa	10.12
Water	9.80
Protoxyd of iron	21.53
Loss	0.89
	1,000

But the substance varies very materially, as is shown by the following analysis, copied from Professor Cook's Report on the Geology of New Jersey. We give the analysis with the decimals abridged from two figures to one:

	1.	2.	3.	4.	5.	6.
Protoxyd of iron	8.3	16.8	21.3		14.9	
Alumina	6.1	6.6	8.0			
Lime	2.4	12.5	1.0			
Magnesia	.4	2.6	2.0			
Potash	2.5	4.9	7.1	7.1	4.3	3.37
Soluble silica	20.2	31.2	45.9			
Insoluble silica and sand	49.9	5.6	4.0			
Sulphuric acid	.9	.6	.4			
Phosphoric acid	1.4	1.1	1.3	.2	2.6	6.9
Carbonic acid	.2	9.3				
Water	7.1	8.9	8.1			
Soluble in water	1.9	1.4	1.1	1.1	1.9	4.7

Marl from the State of Delaware, according to Mr. Booth, does not differ very much from that of New Jersey. But in Delaware there are two varieties, proximate one to the other, and one of which contains as high as 25 per cent. of carbonate of lime. Mons. P. Berthier, professor of Docimacie, in the royal school of mines, of France, has analyzed several varieties, which are more or less analogous in composition to the green sand of New Jersey. The bluffs called Cape La Hève, near Havre, in France, are mainly formed of carbonate of lime, through which are interspersed nodules and grains of a dark-greenish substance, which yielded:

Silica	50.00
Protoxyd of iron	21.00
Magnesia	7.00
Alumina	11.00
Potassa	10.00
	99.00

The grains of chlorite are found isolated and distinct in the limestone at Havre. Analysis represents the composition of those grains free from the mass in which they occur. The analysis of Mr. Seybert exhibits, as I have understood, the average of the deposit as it came

from the ground. If it be otherwise, and the particles of chlorite were selected previous to analysis, the green sand of New Jersey would be infinitely less valuable as a fertilizer than is indicated by the above analysis. In other parts of the United States, other substances of an entirely different composition have received the name of marl, and been applied to the soil with marked advantage. Such a substance is found in the environs of Pendleton, in South Carolina, where it has attracted attention. It is a variety of kaolin, or decomposed feldspar, one of the constituents of granite, containing little or no lime, but sometimes as high as 17 per cent. of potassa. At Fort Hill, the residence of the late J. C. Calhoun, this substance was found in digging a well. It was used in dressing the lawn in front of the dwelling, where its fertilizing effects are manifest to this day in a luxuriant sward, contrasting vividly with the surrounding vegetation on which the application was not made. In 1837, some years after the experiment, it was pointed out by Mr. Calhoun as an illustration of the adaptability of that country to produce luxuriant grass, if the soil were properly treated.

We speak of marl as always containing the calcareous principle, in which sand, clay, or carbonate of lime may predominate, it accordingly receiving the appellation of sandy or clay marl, as either principle may be in excess. Few marls are free from admixture with the above-named substances, and sometimes others are found, such as oxyd of iron, sulphuret of iron, manganese, sulphate of lime, &c. The majority of our soils east of the mountains, originate from the old granitic schistose and sandstone rocks, which are wanting in the proper proportions of lime to make them as fertile as those soils having a different origin. Animals fed on the grass grown upon limestone land, or those artificially limed, thrive much better than when pastured upon lands of a different character. It is also known that wheat weighs heavier, has a much better appearance, and is invariably preferred by millers when grown upon calcareous soils. It is, then, of importance to the agriculturist that he should possess a knowledge of the presence or absence of lime in his soil, and how to make examinations, both qualitative and quantitative, for that substance or minerals supposed to contain carbonate of lime.

No mineral varies more in its physical character than marl. It occurs of all colors, from black to white; and frequently in the same bed you have a variety of tones, as there may be present more or less oxyd of iron; or according to the state of oxydation of that metal, you may have the red, yellow, brown, blue, and the different shades which a mixture of these would create when variously mixed with white, black, &c. Sometimes it is smooth and without grit; at others it has a coarse grain, with crystals of other mineral substances disseminated, such as sulphate of lime and quartz. Chalk is a marl, through which nodules of flint occur, sometimes in large quantities, and sometimes the carbonate of lime disappears altogether, and is replaced by silicious matter. Very often the bed may be wholly composed of shells, broken or entire, or even invisible to the naked eye, but revealing through the microscope the remains of minute organisms forming the complete mass. It is sometimes soft and unctuous to the touch, friable, or hard. But it has one general property, of falling into powder when exposed

to the air, or forming pasty mud when saturated with water, and acts very like lime in the process of slacking, without giving off heat.

A marl is valuable in proportion to the amount of carbonate of limo that it contains. Take a piece of the substance suspected to contain the carbonate, large as an acorn, throw it into a tumbler or wine-glass, and cover it with water; after the air has escaped from the interstices, add a few drops of any acid, say nitric or muriatic, or either of these being wanting, strong vinegar may suffice; then, if there should be a disengagement of gas, or effervescence, it is pretty sure evidence of the presence of carbonate of lime. In order to ascertain, rigorously, the amount of carbonate that may exist in the mass, we should select an average sample. The first operation consists in drying perfectly, to drive off the hygrometric humidity, which varies according to the state of the atmosphere. Reduce the matter to powder, if it requires it, and place it upon a plate. By setting the plate upon a vase containing boiling water, and maintaining the temperature for a sufficient time, all the water not combined will be driven off; and this may be ascertained by placing over the powder a glass funnel, on the inside of which the humidity will be condensed until it entirely ceases to appear. The funnel serves another purpose, that of excluding any accidental impurities, and preventing the steam, which naturally escapes from the water below, being condensed upon the powder. When the substance is thus perfectly dried, weigh fifty or one hundred grains, and place them in a silver or iron spoon,* and heat over a few live coals to a dark cherry-red. If the presence of organic matter be suspected, the powder may be carefully stirred with a piece of clean wire, in order to bring the different parts in contact with the atmosphere, when any carbonaceous matter will thus be burned. Now let the powder cool, weigh it carefully, and you have the amount of combined water or volatile matters driven off. The heat should not be so great as to drive off the carbonic acid from the lime.

Throw the powder thus calcined into a glass tumbler, and cover it to the depth of half an inch with rain-water, to which add, by degrees, a few drops of nitric or muriatic acid, until you find that the addition of the acid produces no more effect. Mix the whole with a glass tube, cover the glass, and let it stand for several hours. Now fill the glass two thirds with water, and let it settle. When the sediment, or insoluble portion, has subsided, and the liquid is perfectly limpid, decant it carefully into a large bottle, and put more rain-water on the sediment, allow it to settle, decant again, and repeat the operation until the sediment is entirely cleansed of the acid solution. This may be verified by taking a piece of clean glass, and putting a drop of the solution upon it. Now, if you hold this glass over the fire until the drop of water is evaporated, you will find it sufficiently washed when there is no residuum left on the glass. The lime, magnesia, some alumina and iron, if they are present, will be found in solution in the water decanted. The sediment, which was not dissolved by the acid, contains the sand and insoluble substances. This may be collected upon a filter, carefully dried, separated from the filter, calcined in a spoon, as before, and cooled and weighed.

* We mention the iron spoon as a substitute for the preferable platina crucible.

If the solution be very acid, or the amount of water too large to manage well, they may be collected and evaporated to dryness over a slow fire; by this operation the excess of water and acid is driven off which may also be performed in a porcelain capsule, but by no means employ a metallic vase, as the acid would dissolve the metal, and your labor would be useless. When the excess of water has been driven off, together with the excess of acid, if the heat has not been carried too far, the whole will be found to re-dissolve in rain-water, to which a drop or two of acid may be added to insure that result. You now have nearly a neutral solution of the salts dissolved by the acid.

The next operation consists in precipitating all the constituents held in solution, less the lime. For this purpose use lime-water. To prepare lime-water, put lime, say a piece as large as a walnut, in a bottle of rain-water, shake it well, and allow it to settle; decant, and you have a limpid solution of lime in water. This water, added to the solution containing the soluble substances of the marl until a further addition produces no further precipitate, throws down everything in solution but the lime. Let the precipitate settle and decant. Throw the precipitate in a filter, and carefully collect, dry, and weigh. Your analysis will stand thus:

Volatile matter, water, organic matter, &c.	W
Insoluble residuum, sand, silicates, &c.	X
Precipitate by lime-water, iron, magnesia, &c.	Y
Carbonate of lime, by difference	Z
Equal	100

If it should be thought desirable, either of the quantities X and Y, may be taken up separately and examined in detail. If phosphoric acid be present, it will be found combined in the precipitate Y, in combination with the iron or magnesia.

The above method is one that we have practised very often, and is the most simple that we can offer to the inquiring reader, who has not devoted much of his time to chemical examinations. If performed well, the results will be found as exact as any other method; and the reader will please understand that, in giving this, we do not write for the professed chemist, but to enable the educated farmer to make an analysis in which he can confide, rather than pay a sum of money, often for false returns, with which the charlatan is always ready.

In deposits of marl there are frequently different layers, varying in appearance, thickness, and composition. The lower strata are often richer in lime than the upper. An argillaceous layer sometimes overlies one that is sandy, and one or the other will be selected as the land to which it is to be applied may be sandy or stiff. Sea-sands are, in many cases, applied to the soil with great advantage, and it is not surprising, for they are frequently composed of minute fragments of shells, comminuted corals, and the remains of minute organisms, which are found inhabiting the ocean—Nature's great reservoir of life.

But the action of marl cannot be entirely owing to the carbonate of lime. There are effects due to other causes, and it would be strange

indeed, considering the origin of these fertilizers, if they did not contain some of the more evanescent principles of organic life. Mr. Payen and Boussingault, both celebrated chemists, instituted a series of inquiries into the composition of marls, from different localities, and found nitrogen in all. "It were therefore very proper, in analyzing marls, chalk, &c., to have an eye to their organic, or azotic, as well as to their mineral constituents. There can be very little question of the azotized elements being at the bottom of the really wonderful fertilizing influences of the marls of certain districts."*

It would be still more surprising if a substance less ephemeral in its nature, and not less important, should not be found more constantly in limestones and marls than former analysis has shown. Phosphoric acid at all times complicates analysis, is difficult to appreciate correctly, and has doubtless been largely overlooked. But there is higher evidence of its almost universal presence than chemical tests, for wherever organic remains are found, it is a sure indication of that singularly interesting substance, phosphorus, to which we attach as important a role, if not a higher one, than that attributed to nitrogen, by the celebrated authorities mentioned above.

Marl, after extraction from the pit, should be exposed as long as possible to the action of the atmospheric agents. A summer's heat and a winter's cold, previous to spreading, make its immediate action manifest; but its durability is dependent upon its contents and the quantity applied. According to Mr. Parvis, who has written an interesting and useful paper upon marl, the quantity to be applied depends upon the quantity of lime already existing in the soil and the richness of the marl in lime. He says that any soil which contains less than nine to ten per cent. of lime may receive a dose, or successive doses, until they are brought up to that point. Lord Kames mentions a particular instance of the continued beneficial effects of calcareous manure for one hundred and twenty years, and Johnson quotes the words of an intelligent and experienced farmer, that certain lands in Scotland "would never forget an application of forty to sixty bushels of lime to the acre."

Lime appears to change the inert organic matters in the soil and give durability to their action far beyond what would have been the case without the presence of that mineral. It also changes the relations between the other mineral constituents of the soil, and is an essential element of plant food; but there are other substances quite as necessary to healthy vegetation. It follows, then, that whoever may expect to harvest large crops immediately from the addition of lime to poor land will surely be deceived. The proportion of marl or lime to be added to a soil should be in accordance with the amount of organic matter already existing in it, or that may be contributed; in other words, the lime should progress *pari passu;* and by following such a course, the land may be brought to a state of permanent fertility, to which it never could be carried by farm-yard manure alone. What would be an over-dose of lime to one field would be a light dressing for another. An over-dose of marl or lime may altogether prevent the

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* Boussingault, Rural Economy

appearance of vegetation, or cause a sickly growth. Mr. Ruffin says that manure is a remedy for such effects. Interesting and important as the subject certainly is to the farmer, the nature of this article will not permit us to extend our observations further, and the reader is once more referred to Mr. Ruffin's work on calcareous manures, in which will be found much detail not written elsewhere.

Limestone is one of the principal rocks which forms the solid crust of the globe. It has a large development, and is intercalated with the primitive rocks. It occurs there in a saccharoidal form of different colors—grey, blue, red, &c., but never black. A notable fact is that no fossils of any description have ever been discovered in primitive limestone. It is often found schistose in its structure, from a mixture with other rocks, particularly mica schists. As we rise in the geological series, the limestones preponderate, and become by far the most important of rocks. Instead of being subordinate and alternating with others, they now form independent developments, of vast extent, constituting mountain ranges. The character of the rock is also changed. It occurs of all colors, from black through every shade to white. The mixture of foreign minerals is less notable; but there the first appearance of organic remains is a most significant and interesting fact. At times, no fossils are to be found; and one may travel for miles without meeting with a single specimen; when, all at once, they occur in prodigious quantities. The fossils of this formation are all characteristic; and without giving a detailed list, I will mention Orthoceratites, Spiriferes, Encrinites, and Trilobites. In the secondary formation, the carbonate of lime may be said to constitute the almost entire series of superpositions. The secondary formations are divided into several series known by different names in various parts of the world. The lowest of these formations immediately overlying the intermediary is called Zechstein by the Germans, and occurs compact of a greyish-black color, sometimes bituminous, and gives off a fetid odor when rubbed or receiving the shock of the hammer. It is characterized by certain fossils, and is separated from the formations immediately underlying, as those overlying, by arenaceous sandstones of a peculiar nature. The red marl or great mushelkalk limestone is the next series as we travel up. In general, this stone is found less highly colored, and contains fossils, all of which differ from the Zechstein, and occur in much greater abundance. In traveling over Germany we have often spent hours in studying this interesting rock through its fossils, which would show themselves at different localities on our journey. There is one in particular, the Encrinites Liliformis, of singular beauty. They are rarely found entire, but when they do so occur they cannot fail to excite the admiration of the observer. Rarely as the entire plant is found in one specimen, so common are parts of it, that the rock at times would appear to be formed of them.

A third deposit now occurs, and is known in England by the name of Lias, also characterized by particular fossils; and here, for the first time, we see Belemnites, and Ammonites, and a large number of shells, peculiar to that formation. Another deposit, which is known as the Jura limestone in France, oolite and coral rag in England, and which subdivides again, is, with its antedivisions, distinguished, the one from the other, by the fossil re-

mains found in them. In the upper part of this division we have certain varieties of marl, such as that at Havre, in which the chloritic grains occur, as analyzed by M. Berthier; and in England, at Purbeck and Portland, are found marls, where fresh water shells show themselves for the first time. The fifth deposit of the secondary series, separated from the last described by iron sands, is the chalk formation, which may be divided into green sand and true chalk. These formations contain fossils which are characteristic and such as are found nowhere else.

The next in order, and superimposed upon the preceding, is the tertiary formation, so interesting for the number and character of its organic remains. Around the city of Paris, the student has an opportunity of studying this formation perhaps better than at any other locality. Montmartre, so celebrated for its geology and paleontology, as well as for other reasons, is really classic ground. The remains of extinct animals, buried from incalculable time, were frequently extracted by the workmen engaged in quarrying out material for construction. From the study of such remains the genius of Cuvier opened a new creation. Fragments of bones of extinct animals, that were gazed upon by the curious, and received no other explanation than "*lusus naturæ*," were classified, each bone to its proper place; and each animal according to its habits, which were pointed out by its teeth or its osteology, was assigned its appropriate position in the gradation of animated Nature. Though extinct, their general habits are known as certainly as if they were domesticated under man, and belonged to the present time. Science has placed a wreath around the brow of Cuvier, that will endure to his honor so long as civilization shall be in the ascendant.

The first plaster of Paris used in America for fertilization came from the hill of Montmartre, and was imported under the auspices of Franklin. Above the tertiary formations are others of a much more recent date, and now forming under our eyes. Many of these are mainly composed of limestone, made up from the destruction of other calcareous rocks. Along our sea-coast such rocks are forming, and even furnish building material. Tufaceous deposits are making in our valleys, by the deposition of carbonate of lime from water issuing from limestone rocks. Immense beds of shells, such as are living in our waters, are found along our coast. In Prince George's county, Maryland, the marl-beds are well-known, and the celebrated lands of that region owe their fertility to these remains of a former life. Among these fragments, bones and teeth of animals are not uncommon; and whole skeletons have been disinterred and set up to be wondered at. The remains of the mastodon, (an animal of the elephant tribe, but much more gigantic,) are frequently met with, and an almost entire specimen was taken up in the interior of the State of New York. Sharks' teeth are also common, sometimes of enormous size. We have one in our possession, taken from a bed in Prince George's county, that measures about four inches in breadth at its base and nearly five inches in length. It is in perfect condition, its cutting edges as finely and sharply serrated as if just taken from the monster's mouth.

Nor is the limestone formation of our continent confined to the

recent deposits of which we have spoken. The blue limestone formation, so celebrated for its excellent wheat lands in Pennsylvania, Maryland, and Virginia, continues through Georgia, comes to the surface near Clarksville, in Habersham county, and extends to the Island of Cuba, where we have traced it again for miles.

The limestone lands of the State of New York are celebrated for their fertility and the magnesian limestone of the great west has prodigious extension.

In closing our observations upon lime, we will remark that of all mineral substances it is among the most extensively diffused, so much so that it would be impossible to find a soil without it. An amateur asked us if we had ever found lime in the soil on which we lived; he thought it absent. We answered that, even if we had failed to detect it with the aid of reagents, there was higher evidence of its presence, which could not be contradicted, namely: the bones of the animals reared upon the place, the eggs of our hens, and the houses which snails carried upon their backs.

Those who desire details upon the green sand marl of New Jersey and Delaware, will do well to consult the reports of Messrs. Rogers and Booth; the former was charged with the geological survey of New Jersey, the latter with that of Delaware.

PLASTER, OR GYPSUM.

It is probable that the "marl" of the ancients was plaster of Paris, or gypsum, but it was not until near the close of the last century that its incontestible utility became known; since that period it has become almost a necessity; nor is it surprising that such should be the case, when we consider its efficacy on certain crops, the small amount required to produce a great increase, and the facility with which it can be procured and prepared. The first authentic experiments of which we have record were made by a German clergyman, named Meyer. These were repeated in France, when it soon grew into extensive use. Sulphate of lime, as its name indicates, is composed of sulphuric acid, lime, and water.

$$\left.\begin{array}{ll}\text{Sulphuric acid} \ldots\ldots & 46\\ \text{Lime} \ldots\ldots & 33\\ \text{Water} \ldots\ldots & 21\end{array}\right\} = 100$$

It is unusually soft, and may be scratched with the finger nail. When pure, it is generally of a whitish color, but according as it is found mixed with foreign matter its color varies. It assumes a variety of forms, compact, granular, fibrous, pulverulent, crystaline, &c. Its crystals are sometimes perfectly limpid. Gypsum is plentifully and widely disseminated throughout the crust of the globe, and is confined to no age or particular formation. In some cases it would appear to owe its existence to the decomposition of the sulphuret of iron in contact with limestone or, again, to the action of sulphurous vapors upon that rock. It is not often fossiliferous; but that which is found at Montmartre, in the environs of Paris, is an exception. At that locality

the remains of mammiferous animals, of birds, and reptiles, are very common. In certain formations the sulphate of lime is usually found accompanying common salt. It is also a constituent of some of the marls, which occur along our sea-coast, but only to a limited amount, comparatively. In the State of New York it is found in large quantities, and also in Novia Scotia, whence it is imported into the United States, forming by far the greater portion of that which is used by the farmers of the Atlantic shore.

Notwithstanding all the experiments that have been made, and all that has been written upon the subject, our knowledge of the action of gypsum is limited and very unsatisfactory.

Sir Humphrey Davy analyzed the ashes of clover, and concluded, from the presence of sulphate of lime, that the application of gypsum acted as direct food. But subsequent investigations show that the amount of sulphate of lime in the ash of clover, grown upon gypsumed land, was not greater than the quantity of the same salt, found in the ash of clover, grown on ungypsumed land.

Professor Liebig explains the action of gypsum, as a means through which ammonia is presented to the plant. It is known that ammonia and nitric acid are found in the atmosphere, and that salt and carbonate of ammonia are brought down by rains. That fact may be easily verified by evaporating snow, or rain water, to which a few drops of muriatic acid have been added; crystals of muriate of ammonia will be found. Indeed, without consulting the agency of electricity for the formation of ammonia, it is a natural consequence of the decomposition of animal matters, which is ever progressing upon the surface of the globe, and many plants emit pungent odors, apparently containing more or less of that alkali. According to the eminent professor, the action of gypsum would be confined to the absorption of that gas, to be held in readiness, according to the wants of the plant. But his ingenious theory is no less satisfactory, for it is stated that gypsum has no action whatever on the natural gases, which are stimulated by organic manures. Nor does it appear, from careful experiments made by M. Boussingault, that gypsum has the least action upon wheat, oats, or rye, upon which it is known that nitrogenous manures act most favorably. Rigaud de Lisle, in a paper read before the Paris Society of Agriculture, in 1843, maintained that gypsum only operates upon vegetation grown upon soils without a sufficient amount of carbonate of lime, and his declaration is borne out by the practice in Flanders of applying slaked lime, instead of gypsum, with equally good results. We have heard the same opinion expressed by practical farmers, who knew nothing of the discussion. Having limed their lands to the full requirement, they would look upon the application of plaster as a useless expense.

SULPHATE OF BARYTES.

Another assertion, which has its advantages, gives the entire credit of the action of gypsum to the sulphuric acid which it contains; and this appears to be supported by the fact that the addition of the sulphate of barytes is followed by as strongly marked results as those that are

derived from the application of the sulphate of lime. Experiments were made some years since in Rockbridge county, Virginia, by Dr. Barton, upon whose farm a deposit of the sulphate of barytes was found. It was ground and applied. We are informed by an intelligent observer that the effect was manifest five years after. A paper was written at the time, and published in one of the agricultural periodicals of Virginia. We have not had access to the article, but Dr. Barton received the award of a gold medal for his investigations. Should the usefulness of sulphate of barytes be confirmed, it will be a notable and important addition to the list of fertilizers. It is sometimes called *heavy* spar, owing to its specific gravity, which is almost double that of gypsum or the sulphate of lime; the first being 4.7, and the latter 2.72. Generally it is found white, or reddish, yellowish, white, grey, and even black, compact, granular, crystaline, &c. Insoluble in water, and when decomposed, as may be done by calcining together powdered charcoal, or sugar, starch, resine, &c., with sulphate of barytes, the barytes will dissolve in nitric or muriatic acid, from which it will always be precipitated by the addition of sulphuric acid. It will be recollected that the sulphate of lime is sensibly soluble in water, more so than lime, for when sulphuric acid is added to limewater no precipitate is thrown; whereas, when a few drops of sulphuric acid are added to a solution of the nitrate, muriate, or to the oxyd of barytes in solution, a white precipitate never fails to fall. The carbonate of barytes may be easily distinguished from the sulphate by its effervescing, as it does slowly on the application of nitric acid. It is composed of—

$$\left.\begin{array}{ll}\text{Sulphuric acid} \ldots\ldots\ldots\ldots & 34.37 \\ \text{Barytes} \ldots\ldots\ldots\ldots & 65.63\end{array}\right\} = 100$$

It is, however, often found mixed with different substances, such as sulphate of strontian, sulphate and carbonate of lime, silex, oxyd of iron, and alumine. It occurs in veins in the primitive and secondary rocks, and is most always found in veins of lead, copper, silver, and mercury; in the metalliferous regions of Europe, in the Hartz, Saxony, Hungary, Almaden, in Spain; in the United States, in New York, Connecticut, New Jersey, Pennsylvania, Maryland, Virginia, Missouri, &c.

Owing to the great analogy that exists between the characters of the salts of strontian and those of barytes, it would be surprising if the fertilizing properties attributed to the one were not common to both, particularly if the acid were found to be the active fertilizing principle as well in the sulphate of lime as that of barytes; other sulphates, such as the sulphate of iron, (green vitriol,) when much diluted with water, without the presence of lime, have extraordinarily advanced the growth of plants, including beans, potatoes, rye, Indian corn, carrots, &c. Weak sulphuric acid has also a favorable effect when applied to clover, but in both cases it may be argued that the sulphate of iron, (which is soluble,) and the sulphuric acid come in contact with lime in the soil, and sulphate of lime is then formed, and may act in that state upon crops; or the acid, in one case or the other, may combine with ammonia, already existing in and combined with the earth, and form sulphate

of ammonia, which is a valuable and well-known fertilizer. But we will here remark that, in our laboratories, the sulphate of barytes is found to be one of the most stable of salts, and its combination is in no instance decomposed by lime or ammonia. Nor does barytes form a constituent of any vegetable or animal organism within our knowledge. A small quantity of the nitrate of barytes will destroy vegetable life very quickly; yet nitric acid is a strong fertilizer, and one of the principal furnishers of nitrogen to plants.

MAGNESIA.

Magnesia is a common substance, largely disseminated, existing in most soils, is one of the constituents of many rocks, and is most always present in vegetables and animal bodies. It is a white, light, and odorless powder, infusible at the highest temperature of our furnaces, and slightly soluble in water. It forms soluble salts, with nitric, muriatic, or sulphuric acid, and may be easily distinguished from lime, by the fact that it is precipitated from its solution by limewater. It is generally found in combination with lime in all calcareous rocks, and in certain varieties it is a constant constituent; such are the dolomites, or magnesian limestones, which are largely developed in Europe, as well as in America, and have received the name of metalliferous limestone, from the mineral substances which they contain. Magnesian limestones are found to an immense extent, in the western States, and constitute the lead and copper-bearing rocks of Missouri, &c. They are also found in New York, Pennsylvania, &c. Magnesia is moreover, one of the constituents of serpentine and talcose slate, which last-mentioned rock extends continuously from Pennsylvania to Georgia, and through the West Indies, to the continent of South America. It is remarkable as being the formation in which gold, silver, copper, chromate of iron, &c., are contained. The carbonate of magnesia and the carbonate of lime have many properties in common, the one replacing the other, and those plants which grow upon magnesian soils, contain the carbonate of magnesia instead of the carbonate of lime. Those two salts being isomorphous, according to Bergmann, magnesia forms an important part of some of the most fertile soils, and of the mud of the Nile. Einoff mentions a marl of extraordinary merit, which yielded him as high as twenty per cent. of the carbonate of magnesia. Stöckhardt says that the most famed lime stone in Saxony is a dolomite; and eighteen analyses, each specimen being from a different quarry, yielded from forty-one to forty-four per cent. of carbonate of magnesia. It is carried from the quarries to a great distance, because these limes, from undoubted and universal experience, act more powerfully and at the same time more permanently than other kinds of Saxon lime, although many of these latter are extraordinarily pure. The same eminent observer states, that well-known recent investigations of the ashes of various kinds of corn grains show a percentage of magnesia of 11.1 grains, against 3.4 of lime; and the analysis of the ashes of twenty kinds of peas, grown in the most varied soils and districts, of 8.3 to 4.5. With very few exceptions, a similar preponderance of magnesia is exhibited by other kinds

of seed, so far as their mineral constituents have yet been examined, for the proportion of magnesia exceeds that of lime, in approximative round numbers, two to one in peas, beans, vetches, quince, buck wheat, linseed, &c.; two and a half or three to one in wheat, rye, oats, coffee, &c.; six or eight to one in maize, millet, and in the seeds of pines, firs, &c.

On the other hand, the opposite condition occurs regularly in the leaves and stems of plants, and in the wood of trees, in which lime has always the superiority over magnesia, and exists in two to eight times greater quantity, whence he deduces the law, that magnesia is especially necessary for the maturation of the seed, and lime for the development of the herbaceous and woody structure.* Lampadius also thinks this substance particularly favorable for the production of rye.

We have dwelt upon this subject, because much injury has been caused to agriculture by the prevalent opinion that the presence of magnesia in limestone, when calcined and applied to land, was followed by bad consequences. Much has been written to explain the cause of this, as we consider it, imaginary evil. Caustic magnesia, or magnesia without carbonic acid, may absorb carbonic acid much more slowly than lime, and in the presence of the latter substance, it will not combine, until the lime has been saturated; yet after all that has been stated, it would appear less than probable, that the presence of caustic magnesia should play so unfavorable a part, and so contrary to experience.

The salts of magnesia may be employed, as the salts of lime, for fixing ammonia, but in that case its application will depend upon its cost. When a salt of that base is added to urine, it produces a precipitate of the phosphate of magnesia and ammonia. Caustic lime, containing magnesia, is used for this purpose; but owing to the bulk of lime, the amount is rendered less portable. The phosphates of magnesia and ammonia, when applied at the rate of one hundred and thirty to two hundred and sixty pounds per acre, had a powerful effect upon the production of Indian corn; at the rate of three hundred weight per acre, it increased the crop of grain six times, and of straw three times.†

Magnesia is a constant and important constituent of sea-water. It is also found in many mineral waters, and to this fact their virtues are attributed. As it usually exists in the ashes of cultivated plants, its presence in the soil is a requisite to fertility, and its addition of manifest necessity wherever it may be wanting.

PHOSPHORUS.

Of the substances with which the farmer has to do we think phosphorus the most important. It is found in all animals and vegetables; without it neither the one nor the other could live. It is detected, if not pure, as has been stated frequently, in combination with a particular organic substance, in the brain, the spinal marrow, the spermatic liquid, in the melt of fishes, certain mollusca, &c. It is also diffused very widely, and is discovered in combination with oxygen in all rocks, in all soils, and

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* Stöckhardt's Agricultural Chemistry.
† Johnston's Agricultural Chemistry.

in the flesh, bones, &c., of fish, reptiles, insects, birds, animals, and their secretions. Some of the fossil excrements of extinct animals are extensively and advantageously used as fertilizers. Wherever there are organisms, either vegetable or animal, or their remains, it is very strong evidence of the presence of phosphoric acid. It is detected in almost all limestone rocks, and particularly in those containing fossil remains. Close investigations show its presence in the older crystaline rocks; and where it has not appeared as a constituent in any analysis made hitherto, we do not look upon that as evidence of its absence, for the reason that this substance was not suspected, and the analysis were generally conducted in a manner to ignore its presence. Besides, all who have analyzed much know that phosphoric acid is a great complicator, and requires special attention and care to appreciate. In small quantities (and all analyses of minerals must be made upon small quantities to give exact results) it may be overlooked, and its presence not even suspected. We feel confident that future research will prove what we have stated to be perfectly true.

Organisms exist, procreate, live, and die, wherever there is heat, air, and moisture. They are in the air, in fresh and salt water, in the arable soil; and their remains constitute the principal mass of immense calcareous formations. It would appear that they are found from the equator to the regions of eternal ice; and according to the observations of the learned Ehrenberg, have been discovered at work in certain localities to the depth of twenty or thirty feet.* If they make a portion of all animated bodies, it follows that this interesting substance is omnipresent, and plays a part in fertilization much more important than has hitherto been attributed to it. An alchemist in Hamburg first discovered phosphorus by evaporating urine and calcining the residuum. Though this was done in 1669, by Brandt, it was not known to the public until many years after, when Gahn and Scheele extracted it from animal matters, and explained their process of obtaining it from the bones of animals, a mode pursued up to the present time. It is a simple substance, of a yellow color, tough, and resembling wax. It may be procured in three states, solid, liquid, and gaseous. At the temperature of freezing water, it is hard, brittle, and even friable. It crystalizes, and its density is about 1.77. Phosphorus, when exposed to the air, is luminous, owing to the fact that it absorbs oxygen and undergoes a slow combustion. Hence its name, from two Greek words, which signify light-producer. When inflamed in the air, or in oxygen gas, it produces white fumes, and when collected free from humidity, is white, pulverulent, and absorbs the humidity of the atmosphere, or deliquesces, and becomes liquid. This combination of phosphorus with oxygen is called phosphoric acid. It inflames easily, and produces obstinate wounds; therefore, it is kept under water, and handled with pinchers. In this condition it may be melted without danger, and is purified by distillation and filtration through buckskin under hot water. Phosphorus combines with oxygen in several proportions; but we shall only dwell upon that which

* See Ehrenberg on Infusoria, and his researches as to the cause of the instability of foundations under the city of Berlin.

contains five atoms of oxygen and one of phosphorus. Phosphoric acid, when perfectly pure, and thrown into water, combines with that liquid with so much rapidity that it produces a noise like that caused by plunging a red-hot iron in water, and the temperature of the liquid is elevated. It is found in Nature, combined with many other substances, forming phosphates: thus we have the phosphates of lime, magnesia, lead, manganese, iron, uranium, &c.

The phosphate of lime is known under the mineralogical term apatite, and is found crystalized in stalactites, granular, fibrous, compact, and friable. It is sometimes colorless, or yellow, blue, violet, and green, transparent, translucid, and opaque. It occurs among crystalized rocks, such as the granite, gneiss, chlorite, and talcose slates; also in the trap and basalts, and is frequently met with in metalliferous deposits connected with copper, lead, &c., in the slates of coal, in chalk, and in the tertiary formations, as well as in the sedimentary and tufaceous deposits forming at the present day.

A fact worthy of note is the connection of fluoric acid with phosphoric in its combinations, and these two substances are not only found associated together in the mineral kingdom, but in vegetable and animal matters. The teeth of animals contain both. We are disposed to believe that fluoric acid is much more common than has been remarked, and, owing to its singular properties, has been doubtless often overlooked. One of the most extensive deposits of the phosphate of lime is found in Estremadura, in Spain, and was visited and examined by Dr. Daubeny and Captain Widdington, with a view to its introduction into England as a fertilizer. That mineral, according to their analysis, contains eighty-one per cent. of phosphate of lime, and is so abundant that it is used as a building material. In the United States, mineral phosphates are found in many localities, particularly in Morris county, New Jersey, and at Crown Point, in the State of New York. The mineral was crushed and sold in our markets as a fertilizer, but, for some cause not known to us, it appears to have gone out of use.

Since writing the above, we have received the following interesting communication from Mr. F. Alger; as it contains a more full account of the native phosphorite of New Jersey and that of New York than we have seen elsewhere, we append it entire.

"I send you a few facts, as requested, in regard to the deposit of mineral phosphate of lime (phosphorite) discovered by Dr. Jackson and myself in Hurdstown, Morris county, New Jersey, in 1850. Crystals of apatite had been found there for several years previous, but the massive mineral had escaped the notice of all who had, up to that time, visited the locality. I purchased the right to explore the minerals with which the phosphorite was associated, viz: magnetic iron, iron and magnetic pyrites, and early in 1851 I made several shipments of it to Messrs. Jevons & Co., of Liverpool, by whom it was sold to various parties for agricultural and manufacturing purposes at prices varying from *twenty* to *thirty-five dollars* per ton in its crude state. Fine, large masses of the substance were placed in the great London exhibition, at its first opening, and attracted much attention, from their *rocky* character, and being unlike any specimen of the mineral before seen. Professors Daubeny, Johnstone, and others became much

interested in the discovery, and the latter opened a correspondence with me on the subject, setting forth the advantage which would accrue to British agriculture, if, as a substitute for bone phosphate, guano, or coprolites, it could, at a fair price, be introduced into England. At his suggestion, Dr. Richardson, the celebrated manufacturer of artificial manures at Newcastle, made a successful trial of the mineral, and proposed to negotiate for large importations of it into England for his own use. It was also used in the lead smelting establishments, in the making of cupels in the porcelain works, and in the manufacture of pure phosphorus. For the latter purpose, its purity over bone phosphate highly recommended it, and afforded a most expeditious method of obtaining the beautiful glacial phosphate in the hands of Dr. Jackson, who was also the first chemist who made pure phosphorus from it. In its application to the production of phosphate of soda, for which it has been recommended, I have received no information, though it is probable some of the calico printing and dying establishments, where this article is largely used, may have made a trial of it. Should they, or others, feel desirous of trying it, I shall be glad to supply the mineral in moderate quantity, having yet a supply of it on hand. But I have disposed of my interest in the mine to other parties, who have now ceased to work it. The application of the mineral in the United States has been only to agriculture, and to that by no means extensive, though with the best results. For this purpose it is ground very fine, treated with sulphuric acid to produce super-phosphate, and then mixed with wood ashes and thrown into the compost heap, or otherwise distributed upon the land. In some cases the pulverized mineral has been taken alone and mixed with the compost, but in this way a much longer time must elapse before any beneficial effects can be witnessed. One of our practical agriculturists, who has long supplied milk and meat for the market, said that he had been sending phosphate of lime away from his farm for twenty years, and now he meant to carry some back again. He believed that it would pay, even if applied only to grass lands, as he had no doubt it would find its way into the bones of his animals, and thus prevent the impoverishment of his land. The American chemists who have analyzed and written upon the New Jersey phosphate are Dr. Jackson, Dr. Chilton, Professor Mapes, Dr. Antisell, and Mr. Wells, the editor of the Annals of Scientific Discovery. Dr. Jackson's analysis of a very pure specimen, gave of—

Phosphate of lime	92.405
Chloride of calcium	0.540
Peroxyd of iron	0.040
Oxyd of manganese	0.003
Fluoride of calcium	7.012
By difference	

"Professor Mapes found no fluorine in the specimens he analyzed. He obtained:

Lime	61.50
Phosphoric acid	33.85
Chlorine	3.50
Silica	0.09
Iron peroxyd	0.10
Loss	.96

"The mineral phosphate from Crown Point, New York, has been examined by Mr. Wells. It contained 92.85 per cent. of phosphate of lime, only a trace of fluoric acid, 5.20 oxyd of iron, 0.50 silica, 1.50 water. Later analyses make it much more impure. This has been shipped to England by Professor Emmons, who was the first to make it known under its mineralogical name, Eupyrchroite. It is no longer obtained. The phosphorite from the province of Estremadura, in Spain, where it was at first supposed to exist in large quantity, was analyzed by Professor Daubeny, who was commissioned by the British government to visit the locality, with the view of supplying the English market. He obtained:

Phosphate of lime	81.15
Peroxyd of iron	3.15
Fluoride of calcium	14.00
Silica	1.70
Chlorine of calcium	.31

"The Spanish mineral proved veins in clay slate, and was formerly so abundant as to be used for a building stone. It seems, however, never to have been sent to England. The New Jersey deposit is in hornblende rock, as metamorphic sienite, and when discovered, formed a vein from three to five feet in thickness, running parallel with a vein of magnetic pyrites of about the same dimensions, the two being frequently intermixed.

"F. ALGER."

The coprolites, so extensively sought after, and used as fertilizers, are found in various formations, occurring in limited quantity in the mountain limestone; but the lias, green sand, &c., are the sources whence by far the largest amount is obtained. These nodules, in form and even appearance, indicate their origin. The undigested portions of fishes, scales, bones, and distinct parts of things that once lived, show them to be excrementitious matter, solidified by time and pressure. The coprolites vary considerably in their composition, according to the locality, and partly owing to the variety, some yielding as high as seventy per cent. of phosphate of lime, while others give as low as ten per cent. Some contain, beside phosphate of lime, phosphate of iron, and phosphate of alumine. According to Mr. Nisbit, the analysis of five varieties produced:

Tertiary deposit	19.19 to 22.17
London clay	15.96 to 28.00
Chalk	19.00 to 26.92
Green sand	7.72 to 18.81
Green marl	16.47 to 26.56

Coprolites always contain, beside phosphate of lime and phosphate of magnesia, carbonate of lime, and different substances in varied quantities.

It is needless here to state that the phosphate of lime, or we might say, the phosphoric acid, whether taken from the mineral apatite, or any other mineral phosphate, from coprolites fossilized or recent bones, is the same substance and may be applied with the same advantage.

We have said that phosphoric acid, according to our estimate, is the most valuable substance with which the farmer has to do. Silica, lime, magnesia, and alumine are found in abundant quantities in all parts of the earth; nor does it appear that soda and potash require great solicitude, for the latter, which is the most important of the two, enters into the composition of different mineral substances, all very common, and forming portions of the great mass of the globe. We allude to feldspar and mica, both constituents of granite, and of most of the crystaline rocks. Feldspar contains as high as seventeen per cent., while sometimes mica has not less than twenty per cent. of potash. Of oxygen, hydrogen, and carbon, therefore, it hardly requires that we should feel much anxiety about them. The two former substances combined form water; the latter independent of other supplies, is one of the constituents of carbonic acid, a constant part of the atmosphere. Nor do we think that fertility fails so much owing to the want of nitrogen, for that gas is an ingredient of the atmosphere. Wherever it has been taken, at every height, and from every locality, the air we breathe is composed of oxygen, nitrogen, and carbonic acid, holding 79.00 parts of nitrogen. We shall not enter into the discussion of how nitrogen is assimilated, whether directly or indirectly, whether through ammonia or nitric acid, or other nitrogenized components; suffice it to say, that both ammonia and nitric acid are ever forming in the air and in the soil, and that either of those compounds, the admitted purveyor of nitrogen to plants, is a consequence of the existence and decay of organized matters in the air, or near the surface of the earth. By far the larger part of organized matter is composed of the condensed gases. Even during life these gases are given off and replaced by others. After death, decay speedily ensues, and they return to the great reservoir to be assimilated by other vegetables or animals, and thus continue the circle.

Phosphoric acid, though extensively diffused, and sometimes in large quantities, does not appear to be found in the same profusion as the other substances mentioned. The phosphate of lime is a fixed salt, neither soluble nor volatile, and when removed from the soil must be replaced. This is done in the shape of manures, both organic and inorganic; the main sources of the latter we have alluded to. The amount returned from the barn yard is infinitely less than that carried

away in grain, hay, milk, bone, and flesh, even on the most economically regulated farms; and, notwithstanding all our care, there must be a constant decrease of that substance, unless recourse be had to exterior supplies. True, small farms near large cities, may even add more than is taken away, bringing back the refuse of the supplies which are sent to market; but that kind of circulation, from the garden to the market, to the refuse heap, and again to the field, is limited by distance and cost of transportation. Remote lands, from which such supplies are stopped, must in the course of time become impoverished, unless provision be made to replace the continual drain. Exhaustion is but an affair of time; knowing the amount of nutriment in the soil, we may make an approximate calculation, and decide when, under different modes of treatment, it will work sterility. Strong symptoms of a downward tendency in that direction begin to manifest themselves throughout the whole cultivated portion of our country. Indeed, it would be difficult to find, in any part of the civilized world, a more melancholy picture than is presented to the traveler in certain parts of our Union. The exhaustion has not only been caused by continued cropping, and the extraction of phosphoric acid; injudicious culture has had much to do with it, and, perhaps, much the greater part of the fertility has been carried into the streams, thence to rivers, and finally to the ocean. There can be no civilization without population, no population without food, and no food without phosphoric acid. Indeed it might be easily shown, that the march of civilization has followed the direction of supply of that material. There are lands which will not betray the effects of continued cropping, but these are exceptions, and they receive abundant supplies of plant food from some local circumstance. The valley of the Nile is a familiar example; here the annual deposits from the overflow of the river counterbalance the drain. Other lands, composed from the detritus of fossiliferous formations, rich in phosphates, may resist during an indefinite period. The slopes of volcanoes are instances of a different character, where the supplies are restored from ejectments coming from the interior of the earth. The history of the world shows, beyond cavil or doubt, that population cannot endure where the supplies are wanting. Each return of the seasons brings another draft upon the phosphates, and when these fail, civilization takes up another dwelling place. It is not necessary that we should travel far to verify these sad truths. Within the period of a short life, lands were called inexhaustible, which are now worthless; and a great portion of the boundless west is naturally sterile. We are on the eve of a movement from the west back to the east, where a different work is in prospective, that of the regeneration of worn-out land. Perhaps science may be adequate to the task, but the recuperation of a soil will surely be more difficult than cropping it to exhaustion.

If we examine the commercial and agricultural statistics of England for the last fifty years, or even for a much shorter period, we shall be convinced that she never could have attained her present prosperous condition, but from two causes: emigration and the importation of foreign fertilizers. The bones introduced have increased to an enormous extent, during the last few years. "They are principally brought,"

says Maculloch, "from the Netherlands, Germany, and South America. At the present time, however, they form a part of the export trade of nearly every port in the north of Europe." From a report on agricultural shipping and produce, printed by order of the House of Commons, in 1842, we learn that, out of eleven ports of the northern countries of Europe, bones were exported to a large amount, from the following nine: Hamburg, Rotterdam, Bremen, Lubeck, Kiel, Rostock, Stettin, Elsinore, and Danzic. So far back as the year 1827, two hundred and forty-eight vessels entered the one port of Hull, carrying seventeen thousand seven hundred and eighteen tons of bones, which were derived from Russia, Prussia, Sweden, Norway, Denmark, Hanse Towns, Netherlands, Mechlenburg, Hanover, and Oldenburg. In 1835, the importations into Hull alone, had increased to twenty-five thousand seven hundred tons. The value of bones imported into Scotland in 1841, was seventy-four thousand nine hundred pounds sterling. In 1837, the total value of bones imported into the United Kingdom amounted to two hundred and fifty-four thousand six hundred pounds sterling.* This is independent of the home supply which is estimated at not less than five hundred thousand pounds sterling.

The extensive importations of bones, and the application of the native mineral phosphates, (coprolites, &c.,) together with the introduction of guano, have been the main dependence of agriculture in Great Britain during the last twenty-five years. Science, indeed, has aided in making these supplies more active and efficient, great economy having been secured by improved machinery for crushing bones to fine powder, (for the finer the dust the more immediately active it becomes;) but the dissolution of bones with acid has been of still greater benefit. Farm as you may, upon the majority of soils, without the use of extraneous fertilizers, your crops will certainly diminish, until total impoverishment shall leave no other alternative than starvation or emigration.

Science teaches that the principal fertilizing element of the bone is phosphoric acid, and thus, much is saved in transportation and the economy of application.

Bones vary much in their composition, according to the age or variety of the animal. The amount of mineral matter is less in a young animal than in an old one, and the quantity increases gradually with age. Schreger tells us that the bones of a child contain one half of phosphate in the entire mass of earthy matter, while those of a full-grown person give four fifths, and an aged person not less than seven eighths. The bones of adults contain less water than those of children. When a bone is sufficiently digested in muriatic acid, the mineral part is dissolved, leaving the gelatin, or cartilage, intact, which retains the original form of the bone. Large amounts of gelatin, or glue, are thus made. That portion of the bone dissolved in the acid consists of phosphate of lime and magnesia, fluoride of calcium, and carbonate of lime, with small quantities of salts of potash and soda.

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*Morton's Cyclopædia of Agriculture

We copy from Berzelius the following analysis of the bones of man and those of the ox:

	Man.	Ox.
Gelatin, (soluble in water,)	32.17	33.30
Vessels	1.13	
Neutral phosphate of lime	51.04	55.45
Carbonate of lime	11.30	3.85
Fluoride of calcium	2.00	2.90
Phosphate of magnesia	1.16	2.05
Soda and muriate of soda	1.20	2.45
	100.00	100.00

The experiments made by Barras inform us that the proportion of carbonate of lime varies in different animals, as well as in the bones of the same individual. He found, for every 100 parts—

	Carbonate of lime
Bones of a lion	2.03
sheep	24.12
chicken	11.70
frog	5.76
fish	2.52

Chevreuil, Dumeril, Marchand, and other chemists, have analyzed the bones of various fishes; they vary considerably, as will be seen by the following results obtained by the three first mentioned:

	Skull of a cod.	Bones of a pike.	Bones of a whale.
Organic matter	43.94	37.36	78.46
Phosphate of lime	47.96	55.26	14.20
Sulphate of lime	....	....	0.83
Carbonate of lime	5.50	6.15	2.61
Phosphate of magnesia	2.20	....	....
Sulphate of soda	....	....	0.70
Soda and common salt	0.60	1.23	2.46
Fluoride of calcium and loss	....	....	0.74
	100.20	100.00	100.00

The gelatinous part of the bone consists of carbon, hydrogen, oxygen, nitrogen, and sulphur. One hundred parts of gelatin of bones produce, when fermented, twenty-two pounds of ammonia, together with carbonic acid. The sulphur, as we have seen, is also an ingredient of plants.

The phosphate of lime is soluble in all acids, and we may say that all the phosphates are soluble in an excess of acid. When bones are surrounded by fermenting organic matter, such as is offered in a manure or compost heap, the phosphate of lime is dissolved in the humidity by the carbonic acid which is constantly being evolved by

the fermenting mass. This operation is more or less prompt according to the activity of the fermenting heap. In the field, where carbonic acid is always present, this process is constantly going on; but, owing to the presence of the cartilaginous or gelatinous portion which surrounds the particles of phosphate, the action is less apparent on a large bone than if it were in powder, and the finer the powder the more rapid the decomposition.

Many farmers are in the habit of collecting the refuse bones of their farms and covering them up in the accumulating manure in the barn-yard, where, in the course of time, they become soft and pliable, as if they had been immersed in muriatic acid. Such an addition gives increased strength to the manure in proportion as the quantity of bones, which, thus dissolved, becomes immediately active, but endure a less time than when added to the land without preparation. For when bones in large pieces are applied to the soil the action is slow; when divided, more rapid, according to the state of division, and still greater when dissolved, as the state of division is then perfect, provided the operation has been well conducted.

The crushing of bones, owing to their tenacity and hardness, is attended with some difficulty and expense, and, therefore, where the operations are large, steam-mills are employed. But in other places the bones are steamed or boiled, after which they are easily reduced to powder. By that process, however, the gelatinous and fatty matters are extracted and used; the grease for making soap, and the gelatin for fabricating size or glue. We have seen that the organic portion of bones contained fertilizing matter, (nitrogen, sulphur, carbon, &c.) If this be previously extracted, so much is lost to the land; and it is a question of loss to the farmer if the dust be sold by weight. Some burn the bone in order to reduce it to extreme division. Here again the organic portion is entirely destroyed, save only a part of the carbon. It is known that animal black (charred bones) is a great deodorizer and antiseptic, largely used by sugar boilers for refining sugar, and by chemists for whitening sulphate of quinine, &c. It has the property of condensing gases; and charcoal, derived from the calcination of bones, possesses this property to a greater extent than any other substance; it will absorb ninety times its volume of ammoniacal gas. Hence, it becomes a consideration with farmers to know whether they do not gain more by charring the bones than they lose by chasing off the volatile matters. If the bones be burned in contact with the air, the greater portion of the carbon will be driven off with the other combustible parts of the bone; and in order to avoid that result the bones should be charred in air-tight vessels. Iron cylinders are used for the purpose.

Whatever method may be employed, it is important that the bone, previous to treatment with acid, should be divided; otherwise the operation will be imperfect, and particularly so if sulphuric acid be used to form the compound called bi-phosphate, super-phosphate, or acid-phosphate of lime, known to farmers under those appellations. For if the bone, without being reduced to powder, be treated with sulphuric acid, gypsum or sulphate of lime is formed, and that substance being insoluble, surrounds and prevents the further action of the acid

upon those parts of the bone not already acted on. If muriatic acid be employed, that difficulty does not present itself, because the muriate of lime which is formed is very soluble, and so long as acid may be present the decomposition of the bone continues until the operation is complete. In the latter case, the phosphates and muriates would be in solution, which is less convenient of application; this, added to other reasons not necessary to mention, makes it preferable to employ sulphuric acid, which is largely manufactured, and may be obtained everywhere. It is important, however, that the farmer should look to the density of the article, for it is by no means immaterial whether it be strong or weak; otherwise, in the case of the weak or diluted acid, he will be paying for water instead of acid. By the addition of sulphuric acid to crushed bones they are decomposed, and effervescence takes place, arising from the escape of carbonic acid, which has been liberated by the sulphuric acid combining with the lime and forming sulphate of lime, or gypsum.

The insoluble phosphate of lime is decomposed, a part of the lime combining with the sulphuric acid, and liberating the phosphoric acid, which combines with that portion of the phosphate of lime not decomposed, forming a phosphate of lime with excess of phosphoric acid, called bi-phosphate, super-phosphate, or acid-phosphate. The sulphuric acid also combines with the potash, soda, and magnesia. Heat is evolved, the excess of water (if there be not too much) is absorbed, and the mass, when the operation has been well conducted, remains in a dry, pulverulent form. The gelatinous portion of the bone is also modified by the action of the acid, becoming more assimilative. The operation is simple, offering no difficulty whatever. Any farmer may fabricate his own super-phosphate with the implements he may have at hand, and avoid the necessity or risk of paying for an impure article; for every one knows that frauds, to an enormous extent, have been perpetrated upon the confiding farmer, who has often paid high prices for that which was of no value as a manure, and might be had for the collecting.

Sulphuric acid (oil of vitriol) is a substance to be procured in all our markets, and its value depends upon its density, specific gravity, or its state of concentration. The weaker it is, the less valuable. The proper density should be about 1.85.

The quantity of acid required for the decomposition of one hundred pounds of bones depends upon whether they are in meal, half inch, or entire, or whether they are in their natural state, boiled, or burned. The finer the powder the more perfect the action, and the more acid will be required. If the bones are in their raw state, they contain, as has been said, an amount of animal or organic matter, which varies according to the age or species of animal from which they have been derived. The amount of bone-ash obtained from the calcination or burning of bones in contact with the air, may be set down, on an average, at fifty per cent. For every hundred pounds of bone-ash, eighty-seven or eighty-eight pounds of sulphuric acid will be required. The operation may be practiced in a hogshead, on a tight floor, or on the ground, or in the field where the mixture is to be used.

Take, for instance, one hundred pounds of powdered bone-ash, throw

into a hogshead, to which add from five to six gallons of water, and mix with a stout wooden shovel or paddle. Then pour on about eighty-eight pounds of concentrated sulphuric acid. The mass should now be well turned and mixed. It will effervesce and foam up, give off steam in profusion, and the temperature will be found to have risen sometimes as high, or higher, than 212° Fahrenheit. Instead of adding the entire amount of acid at once, it may be divided into two portions, and added separately. In handling acid, have a little care, otherwise an eye or the clothes may be the forfeit, as such accidents have happened. After mixing for some time, the mass will stiffen, when it should be covered, and allowed to stand for a day. It may now be thrown out in a dry place, to remain sufficiently long to be ready for powdering, or it may be mixed with dry peat, charcoal, calcined plaster of Paris, or even dry mold, or saw-dust, and powdered, when it is ready for use.

A mode which is extensively practiced on farms in England was first suggested by Mr. Pusey, and is, briefly, very similar to making mortar out of sand and lime. The circular wall of sand may be replaced by coal ashes, or bone-dust itself. The bone-dust is deposited in the middle of the circle, then thoroughly saturated with water, when the sulphuric acid is added, and the mass well and frequently turned over, until there is no further action. The decomposition is more perfect when the temperature is high, and this is obtained by making the wall of ashes as lofty as possible. The operation is more or less well conducted as the mixture has been the more evenly made, and the parts thoroughly mixed. The mineral phosphorite, coprolites, and varieties of guano, rich in phosphoric acid, may be treated with acids, and will produce super-phosphate of lime, having all the efficiency, and with precisely the same properties of that manufactured from bones, the only difference being that the one may contain salts, which are absent from the the other, and more or less phosphoric acid.

The super-phosphate of lime, from its comparatively high value, leads to adulteration. Water is added to increase the weight; earths, chalks, lime, old plaster, oyster shells, &c., are sometimes mixed in a manner to deceive the eye. Some of these substances may be detected, with the aid of a magnifier, by acids, or by simple washing with water, and examining the residue after decanting. If old plaster is suspected, the hair will be seen; if oyster shells or chalk, the effervescence and particles of shells will furnish indications which will lead to closer scrutiny. The sulphate of barytes, or sulphate of lime, increases the weight of the mixture, and the former particularly will fall to the bottom, when thrown into a tumbler of water, more rapidly than the super-phosphate. Recourse may be had to a chemist, whose familiarity with the properties of different substances will enable him to arrive at conclusions not to be expected from those whose occupations are of an entirely different character.

The loss that is taking place in this most essential ingredient to life (phosphorus) is enormous, unavoidable, and impossible to estimate with any correctness. Independent of that continuous drain which takes place by the washing of the soil, together with the waste ever occurring in provisions of all kinds, grains, vegetables, and animals exported, and but a small part of which finds its way back to the place

whence it came, there is another gradual yet certain loss which, in time, will be felt—I allude to the amount of phosphorus in our bodies—a loss to be attributed to the respectful and pious custom followed in all civilized countries, that of burying the dead. By this practice much is entirely withdrawn from circulation; for the depth at which the bodies are deposited in the ground is below the reach of vegetation. Supposing the inhabitants of the United States at this time to amount to twenty-five millions, and that each individual contains, on an average, four pounds of phosphate of lime, (which will be found not far from the truth,) when this population shall have passed away, one hundred millions of pounds of the phosphate of lime will have been abstracted from the soil, or from activity in the endless change of life.* It will be borne in mind that the extinction of the present generation does not limit the loss; for population increases much more rapidly than supplies; and if we reflect how wonderful has been its augmentation in the United States since its settlement, and its probable continuance, even in a greater ratio, we shall be less apt to underrate the future consequences.

The ocean is a vast reservoir of life's requirements, from which science may find means of recovering supplies, especially of this valuable ingredient.

It is hardly necessary to remark that, while phosphoric acid is an essential part of all fertile soils, it is not the only substance required, for the application of the phosphates may be made without any apparent good result, owing to the absence of other substances not less necessary. With a view to supply every important quality, much ingenuity has been employed in making artificial and saline mixtures, not only to furnish special manures for special crops, but such also as would satisfy the wants of all vegetation. Many saline mixtures may be compounded to increase the efficiency of each other, and at the same time to accelerate, promote, and supply the requirements of plants; but we cannot refrain from cautioning the farmer against the exaggerated accounts now everywhere published in favor of certain fertilizers. They are far from being always what they are described, either in composition or effect, and are very often quite the contrary. At best, composts would frequently appear to be mere dilutions, or attempts at making the truly useful do more service than is possible. The most shameful impositions are being daily practiced. From the nature of the substances employed, these frauds may not easily be detected by the farmer; but he should rather trust, if he will have unusual mixtures, to such as he may manufacture on his own ground, and under his own eye, from materials of positive utility, and purchased from dealers of undoubted character.

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* Monsieur Elie de Beaumont, who has made a similar calculation, in detail, for the amount of phosphate of lime abstracted from culture, by burial, estimates that France has thus lost not less than two millions of tons.—*See Etude sur les Gisements Geologiques du Phosphore.*

The reader will thank us for directing his attention to the above-named work, recently published by our distinguished friend and professor, M. M. L. Elie de Beaumont. We have read it with great interest, and are indebted to the learned author for many valuable suggestions.

VETERINARY SCIENCE AND ART.

BY CAPTAIN JOHN C. RALSTON, PRESIDENT OF THE COLLEGE OF VETERINARY SURGEONS, NEW YORK.

In this country, the veterinary art appears to have suffered, and is still allowed to suffer, unaccountable and most undeserved neglect, in an educational or duly qualified point of view. Its practice has mainly fallen into the hands of the stable-man, the shoeing smith, and the charlatan; for the number of educated practitioners, derived from foreign schools, (chiefly from the Royal Veterinary College, London, or the Veterinary College of Edinburgh,) is very limited, when contrasted with the forcible occasions and wide field for their services, at once to be found in the larger cities and in the farming districts everywhere. Grave considerations, alike creative of surprise on the one hand and of regret on the other, are thereby involved, when due reflection comes to be directed to this state of things: of surprise, because this country has been so quick and ardent as relates to the introduction or improvement of whatsoever otherwise has presented any aspect of benefit or utility; and, assuredly, veterinary science prefers very high claims, whether in relation to agriculture, stock raising, or any other public or social interest, and may be said to be only second to those claims which appertain to the science of human medicine and surgery: of regret, because the horse, first, and after him all other domestic animals, requires, and should have, intelligent and scientific care and treatment in health and sickness, and which can never prove the case where the means of education and right information are wanting. The aforesaid neglect seems the more singular when the vivid example presented by other countries is considered. The veterinary schools of Europe are numerous and highly valued; have been sustained by monarchs, governments, associations, and individuals; and are acknowledged on all hands to have been the sources of no ordinary general benefit; while the attainments and skill of the members of these schools have conferred high professional respect, alike in private life, public or governmental employ, and in the capacity of commissioned veterinary-medical officers of the cavalry and artillery services.

In the early times of Europe and Asia, veterinary art was assiduously cultivated. In ancient Greece, especially, it obtained a leading place, along with the general pursuit of medical and surgical knowledge. The physicians of those days seem to have given coequal attention to anatomical and physiological research and pathological investigation, human and veterinary, and have left behind numerous treatises upon the latter art. By the Romans, veterinary art was also held in much esteem, and their medical and agricultural writers have treated of it with acumen. Among the Moors, particularly during their domination in Spain, solicitous attention was, in like manner, bestowed on the subject. But it were not fitting, here, to seek to enlarge on these remoter chronicles of this estimable science, except to note the forcible

impressions which prevailed in favor of its cultivation in those early times, when flocks and herds held a prominent place, and the welfare of all the domestic animals was well nigh the most important of considerations on the part of communities. The downfall of Rome, and the oblivion of learning during the dark ages, overwhelmed veterinary, as it did all other science. During the later and still rude middle ages, the iron defense, termed the shoe, was adopted for horses' feet, (or, at least, came to be somewhat more used,) and the horse-shoeing of the farrier began to be recognized as an operative art. It was at this period that this craft appears to have appropriated veterinary surgery, (in like manner as the barber craft had become the surgeons and phlebotomists of those days,) and, unfortunately, it continues to be only too generally accepted, that the operator who makes and nails on a horse's shoes, has thereby acquired a knowledge of his diseases and their treatment, which, otherwise, can only be obtained by means of education and the well-trained pursuits and investigations of science.

In the sixteenth century, some effective degree of revival of this always important though so decayed art began to take place. In France, the spark thus rekindled was worthily fostered by Francis I, in a very marked manner. This sovereign caused translations of Vegetius and other ancient writers to be made and disseminated, both in the Latin and modern languages. From this period, in Europe, the step-by-step advancement of veterinary science is to be discerned. In 1761, the French king and government founded a veterinary college at Lyons, which still is flourishing, and in 1776 the present noble institution of Alfort, near Paris, was opened to the public. Subsequently other schools, at Strasbourg, Montpelier, Toulouse, &c., were founded; and these examples were followed by most of the other European states, until now none are to be found without one or more veterinary institutions, enjoying state and public approbation and support.

Great Britain, somewhat singular to be observed, was slow to follow in the footsteps of improvement, in this direction, although a country which, it would seem, should have early recognized the importance of aught relating to the care, treatment, or improvement of stock generally, and of horses more especially. The art of equitation, which had earlier taken a strong hold in England, more particularly from the time of Henry VIII, seems to have (from among its professors, and similarly on the part of one or two human anatomists and surgeons, still later,) contributed better information and practices, and also some publications on veterinarianism. It was not, however, until toward the close of the last century that any general movement ensued, in England, as to laying the educational foundations of this art. Several efforts to establish a school had successively proved abortive; until, in 1792, the present Royal Veterinary College was founded. This institution was projected by M. St. Bel, who had been educated at the school of Lyons, and who became its first professor. He died in 1793, having hardly had time to see the tree he had so striven to ingraft give promise of fructification. St. Bel, by whom some treatises of merit were left, was succeeded by the late Professor Coleman, with Mr. Morehead as colleague; the latter, however, soon resigning in order to go to India, in the service of the East India Company, where, not long

after, he died. By degrees the college began to flourish. It was warmly promoted by George III, who made appointments of its graduates to the various regiments of cavalry and corps of artillery, as commissioned veterinary-medical officers; and it was also aided by annual government grants. The press and public evinced the most favorable approbation of its objects; and the medical teachers, and the profession in general, cordially acknowledged this affiliation claim. The great John Hunter was a veterinary examiner, and an early and zealous friend; and Sir Astley Cooper, who was brother-in-law of the veterinary professor, exerted earnest and active service in its behalf. The school gradually became confirmed in repute, and increased year by year in the attendance of pupils, until, in 1841, after the death of Professor Coleman, the profession was chartered by an act of Parliament as the Royal College of Veterinary Surgeons. This corporate body, the Royal Veterinary College, the Veterinary College of Edinburgh, the veterinary professorships of the London University, Dublin, and the Andersonian University, of Glasgow, combine to afford the means and to be the guarantee of that veterinary knowledge which is claimed in behalf of the domestic animals. What benefit Great Britain has derived from these veterinary schools, her farmers, stock raisers, horse owners, and the public generally, can avouch. Of her horses, it can be said that, despite a climate not favorable to raising the finest races, without certain artificial appliances, they are unsurpassed, and sought for throughout the world; while her cattle and sheep stock have been the sources of improvement everywhere.

And now, let it be asked, how is all this in the United States? The answer must be both perplexing and mortifying. Four or five years back, there was not even the apparent germ of a veterinary school. Some three years since, one was opened in Boston, but which has lately been given up. In Philadelphia, a veterinary association and college are making efforts to secure a creditable footing; and it is to be much wished and hoped that they may succeed. New York has incorporated a college of veterinary surgeons, the prospects and progress of which have, as yet, all to be put on trial. In these young and inadequately aided or sustained efforts is mainly contained the history of the means for educational veterinary science in this country.

The school accommodations of the College of Veterinary Surgeons, of New York, are contained within the Veterinary College Institute, 75 and 77 West 23d street. A brief description may be not amiss here. They consist of a lecture hall, museum room, faculty room, and in a separate building, students' dissecting room, &c. The entrance to these is on the east side; on the west side is the entrance for horses, leading to a noble stable of seventeen stalls, having ample space and light, and thoroughly drained and ventilated. On the same floor is a handsome and commodious office, &c. In a separate building, in the rear, is an eight-box-stall stable, for sick horses, forage loft, &c. The floor below, which is equally well-lighted, drained, and ventilated, contains a seventeen-stall stable, eight box-stalls for horses lame or requiring treatment of the leg-joints or feet; the shoeing forge, which is light, roomy, and well-arranged; a store-room for iron, shoes, &c. Water is introduced to every stall; hot water is supplied in each stable;

a steam drying apparatus is adapted for drying the straw used for the horses' beds; and two ventilator furnaces heat the whole building when required. Every arrangement has been kept in view which is found in the best-planned European stables, and an example is presented of the manner of stalling and keeping horses, wherever comfort, health, and high condition are studied. There is no country to which improved veterinary knowledge, or the treatment which the domestic animals claim, is of greater importance than to this. The horse, who stands in the front rank as regards utility and value, demands primary and corresponding consideration. Any effort to introduce improvements on the housing, management, and stable economics of this noblest subserver of the occupations and enjoyments of man, is worthy of public appreciation and support; and this claim can be well and forcibly advanced for the Veterinary College Institute of New York. As regards veterinary science, in a more generalized sense, it may be further added that its cultivation in this country would be followed by advantages of no limited amount. Among others, it would open for many young men a new professional path, at once attractive and emolumental in pursuit. To medical students it not only tenders opportunities for improving their knowledge, through comparative inquiry relating to animal structure and functions, but, also, for becoming acquainted with the complaints to which domestic animals are subject, and the treatment appropriate, whereby the sphere of usefulness and professional income may be extended. Such opportunities are presented in the classes of the Veterinary College. Another very useful and profitable source of occupation for young men whose educational opportunities or means have been more narrowed, is to be found in the veterinary scientific art of shoeing. Some competent knowledge of the anatomy and physiology of the horse's foot, and the requisite expertness or skill for preparing the hoof, fitting and fixing the shoe, &c., can be acquired by any intelligent young man in two or three months, in the lecture room and the shoeing forge of a veterinary institution; whereupon, by purchasing finished shoes, a business—which, divested of the more rude labor of the forge, may be then very properly termed an art—of a very remunerative nature can readily be established in any town or farming district, by means of only a small capital. Toward this object, courses of lectures on the horse's foot and shoeing, and likewise forge instruction, are proposed to be afforded at the Veterinary College Institute. So essentially important is the art of better shoeing, that, in the tariff of charges annexed to the circular of the institution, a price per set for finished shoes and nails is stated, and the same can be sent to horse-owners, with shoeing instructions, and their smiths can then put on said shoes, charging the same half-price as for removes of shoes; better still, if in every stable and on every farm there were one or more hands who could properly pare and rasp the hoofs and fix the shoes, which would prove a most material economy of time, money, and horses' feet.

The attitude of the veterinary art in Europe has been adverted to, and also its great development in Britain, especially during the present century. The following extract from the London "Times" will more

directly serve to show, in an incidental manner, its elevation in the latter country:

"ROYAL COLLEGE OF VETERINARY SURGEONS.—On Thursday evening a *conversazione* was given by William Field, Esq., the President of the Royal College of Veterinary Surgeons, at the institute of the profession. The spacious suite of rooms were thrown open for the reception of visitors. On the walls were hung several valuable paintings, by Sir Edwin Landseer, J. Ward, R. A., and others. The tables in the board room were covered with microscopes, stereoscopes, and photographic drawings. In the council room, an extensive series of calculi of large size and varied composition, together with numerous morbid specimens, showing the results of disease in our domesticated animals, including several of rare occurrence, such as ossification of the heart, lungs, liver, spleen, brain, were supplied from the Royal Veterinary College, and the private collection of the president. These, together with a minutely digested preparation of the nerves of the heart of a horse, by Dr. Lee, attracted general attention. A select and rare collection of the chemicals and articles of the veterinary *materia medica*, as also specimens of the remedies used by the native practitioners of India, were placed in the library. Several articles of *Vertu*, with busts of Dr. Babbington and Professor Farraday, and carvings in ivory, from busts, by Chantry, ornamented the rooms. The bust of the late Professor Coleman, and cases of electrotyped medals, added to the general effect, and the decorations were completed by several beautiful exotic and other plants, from the Royal Botanic Gardens. The refreshments were supplied on the most liberal scale by the Messrs. Gunter. About one hundred and fifty noblemen and gentlemen were present, including names from every department of science and art. The professors of the Royal Veterinary College, and the leading members of the profession, very ably seconded their worthy president in the duties of the evening."

Veterinary medical departments are connected with the English army, and armies of India, and this has suggested the query, whether a similar department for the United States army would not be desirable, or likely to be productive of utility and benefit? A staff medical officer called recently at the Veterinary College Institute, and observed that the subject had been under discussion or consideration, at one time, in an official quarter. I will avail of the present opportunity, and venture to submit the views I would be disposed to entertain on this subject, so far as the limited means I have access to can enable me to form an opinion. It appears to me that the comparatively limited extent of the cavalry and artillery force of the United States, and the manner in which the respective corps are detailed for service along our extensive frontier, preclude any adequate occasion or opening for a regularly constituted army veterinary department, with its veterinary surgeons attached to regiments and corps. Still, it must not thereby be inferred that the advantages derivable from veterinary science should be denied the army. It is a question only of adaptation, cost, and effectiveness. That system which prevailed in the cavalry and artillery arms of the service in India for upwards of a century, would seem to be well fitted for adoption in an army so circumstanced as that of the

United States. In the India service there were veterinary schools for the sons of deceased soldiers and others, who were trained in a knowledge of the horse's foot, and the art of shoeing. As vacancies occurred, these young men were detailed to the different regiments as farriers. At regimental headquarters there was a farrier major, and to each troop a farrier and assistant farrier. The captains of troops, respectively, acted as the veterinary surgeons, and had a monthly allowance for shoes, medicines, and necessaries. It has often surprised me to note the excellent practical skill evinced by many of these officers, derived from casual opportunities of attendance on veterinary lectures, reading, and observation. The said system worked very well, and would have worked better still if troop-officers had been induced to follow a regular course of instruction, to a certain extent. In this country, were a veterinary professorship instituted at West Point, it might prove the source of much practical utility, inasmuch as the cadets, generally, could attend a series of lectures of a character to interest them, and promote their general range of information, while the cadets of cavalry and artillery could more especially acquire the elements, and lay the foundations of a useful knowledge, which could afterward be valuably extended to their commands. Above all, some acquaintance with the structure and functions of the foot of the horse and mule, and the art of properly shoeing them, would have results of high value, and in like manner some knowledge of the nature and treatment of the more obvious accidents or maladies. Probably officers already in actual service might have opportunities for attendance on a course of these lectures; farriers, moreover, could also be instructed in improved principles of shoeing; and, furthermore, an army veterinary code and shoeing manual could be serviceably compiled. If a permanent professorship of this nature should seem not quite eligible at West Point, then a modified appointment for a certain course of lectures each year might be effected. In the same connection, it may appropriately be observed that army horse-shoes should be supplied, sized, (say eight sizes,) fullered, nail-holed back and front, finished, filed up, and all ready for putting on cold, except it might be a blow from the hammer to close up any too great width of shoe. Machine-made shoes, finished in rough, are as heavy to carry about as in bar, and more inconvenient; require as much forging and finishing; are never as well fitted; and are hurtful and imperfect. In this question, a very important consideration of service, effectiveness, and economy, lies.

VETERINARY MEDICINE.

(*Ars Veterinaria post medicinam secunda est.*)

BY DR. B. F. CRAIG, OF WASHINGTON, D. C.

The benefits which the human race has received from the cultivation of medical science and from the progress of the medical art, are so habitually and universally enjoyed that their existence is hardly noticed and their real extent seldom justly appreciated.

They are enjoyed too much as a matter of course to be duly valued, and too equally by all classes of the community to have their importance illustrated by frequent contrasts of the relative effects of their possession or their absence; and besides this, men are so apt to consider health as their natural and ordinary condition, and to look on every departure from it as an accident that could hardly have been expected, and that should, in the nature of things, be susceptible of prompt and easy correction, that they can scarcely regard with much favor a science which assumes the unpleasant truth, that human flesh is heir to many ills, difficult to escape by the utmost care, and only to be overcome by well-devised efforts.

Instead of the relief that medicine can give to suffering being regarded as a cause of thankfulness, and as a triumph for humanity, the fact that such relief is not always complete and speedy is felt as a grievance, and complained of as an instance of the entire impotency of the art; and in proportion as disease is disarmed of its dangers, and the pangs of suffering allayed, as men are habitually called upon to endure less, does the impatience of what has still to be suffered and encountered increase.

A vent is often sought for this impatience in language directed against medical science and its results—language which men, by frequently repeating, come at last partly to believe; and the perversion of correct views thus brought about is so liable to interfere with the exercise of judgment, that it becomes necessary to set forth and establish the real facts of the case before proceeding to discuss any question upon which they have a bearing.

The results of medical treatment in individual instances can fairly be appreciated only by professional men, and they cannot draw conclusions from any single case, but from a comparison of many similar ones.

It is not like the application of skill and force to inert objects, where the change brought about is a distinctly visible one, and the effects of our exertions are easily distinguishable from those of all other causes.

The real condition of the sick, in the first place, is only to be discerned by the eye of reason and knowledge, and not by the uninstructed spectator; and when that condition is known, the change in it that follows the application of any remedial measures proves nothing, since a change of some sort is constantly going on by the operation of Nature,

which may take one or another direction, in accordance with circumstances almost impossible to appreciate, and to which we may plausibly ascribe almost any event that may occur.

If, in a number of cases, apparently similar, certain changes generally follow certain measures, and but seldom occur in the absence of those measures, there is better ground for reasoning, and conclusions may be drawn which are reliable in proportion to the number and the degree of coincidence of the observations upon which they are based.

Medical science rests upon observations too numerous and concurrent to be much influenced by chance, and derived from sources too independent and various, as to persons, place, time, and country, to be governed by any common prejudice or perverted by any common interest; but while no well-informed person, free from unhealthy peculiarities of mind, can doubt that laws have been ascertained which give a right direction to the healing art, there is still an apparent difficulty in estimating the amount of good that is done, or that probably will be done, by that art.

To form a just opinion on this point, the most proper course would seem to be to inquire into the general amelioration of mankind in all that relates to health and disease, which has accompanied the great development undergone by medical science during the last three centuries.

It were too narrow a view to limit the field of medical science to the sick-room, or to the every-day duties of the physician.

The preservation of health, the proper regulation of diet, of clothing, and of lodging; those measures of hygiene which are applied to cities, to ships, to armies, to hospitals, and to prisons; the means of protection against plague and pestilence, are matters upon which knowledge has been acquired only by a long course of observation and reflection.

However simple some of the established rules may now seem, and however universally they may now be admitted, there was a time, not very remote, when they were unknown or unappreciated; and if we look at their history, we shall find that they have been established in the face of prejudice, false opinion, and false habit, by laborious exertions on the part of those who have made the human body their study.

If the medical sciences had been neglected in the progress of civilization, we have no reason to believe that the increase of material comforts and resources would have more than counterbalanced, if it counterbalanced at all the evil effects on man's physical nature which arise from the luxuries, the temptations, the artificial modes of life, and the increased wear of mind attendant upon the busy struggle of modern times. Whatever superiority, then, in length of days, and in freedom from disease and infirmity, is possessed by the present, as compared with former times, may fairly be claimed as directly due to that science which makes the attainment of such superiority its object; and the amount of this amelioration may best be determined by inquiring into its extent on those points, concerning which we have the most ample and reliable information.

If we take, as a subject of consideration, the average length of human life at different periods since the dawn of modern medicine, we

will find that it has been undergoing a progression, remarkable both for its amount and its regularity; and of this fact we have proofs, derived from various European countries, where, for a greater or less time, records have been made and preserved which give information on this, and on other subjects connected with social economy. The conclusions to be drawn from these records, wherever kept, agree so well as to show that some general cause must have operated in all parts of the civilized world, independently of those historical changes which have affected particular communities. The most complete records of the kind referred to are to be found in the statistics of the town of Geneva, in Switzerland, where a detailed account of the population, of the deaths, the births, and the marriages, has been kept since the year 1549, forming a valuable body of information, an abstract of which, extending from 1549 to 1833, a period of nearly three centuries, has been published, both in French and English journals. It appears, from these statistics, that the proportion of the number of deaths to the number of the whole population, which, in 1600, was one to twenty-five, in the next half century, was one to twenty-seven; in the next, one to twenty-eight; in the next, one to thirty; and in the next, one to thirty-four; and, during the half century lately passed over, the proportion is known to have decreased still more rapidly. We find that the difference cannot, in this case, be explained by a decrease in the number of births, and consequently of the number of persons of the age most liable to mortality.

The average duration of life—that is, the average age of all persons at the period of their death—has increased from twenty-two years and three months at the end of the sixteenth century, to forty years and eight months during the period between the years 1814 and 1833; and not only has this increase of longevity been uninterrupted, but the rate of the increase during the present century is greater than that for any former time.

The probable length of life, which is determined by taking the age to which one half of those born survive, shows a still more striking difference, for from the end of the sixteenth to the middle of the eighteenth century, it increased more than threefold, and from the end of the sixteenth century to the present time, more than fivefold.

It would be difficult to imagine any equivalent that men would be willing to exchange for this increase of life, or to appreciate the amount of sorrow inflicted, if we were to retrograde to the rate of mortality of the sixteenth century; but, for our present purposes, we may view the subject under a different light, and consider only the effect of this alteration on the material prosperity of the community, and its value in that point of view in which the conclusions drawn would apply with equal force to the case of our domestic animals.

The value of man to society is very much in proportion to the length of his life. If he dies early, he fails to make return for the care and expenses bestowed upon his infancy and childhood; if he lives long, and exercises his matured strength and practical skill in industry profitable to the community, he adds by so much to the general wealth.

As the period at which man is fitted for labor does not begin much

before the twentieth year, it can easily be seen how important an element in the progress of the race is a change from twenty-two to forty years as the average length of life; and what an increase of productive industry is implied in that simple fact! But, to illustrate the same point still further, we may take up the question of longevity in another manner.

If we take from the Geneva tables the percentage of the whole number born, who survive to different periods of adult or useful life, we will find it to have varied in different centuries, nearly as follows:

	In the 16th century.	In the 17th.	In the 18th.	In the 19th.
Of 100 persons, there lived to the age of 20....	39	45	56	66
Of 100 persons, there lived to the age of 30....	30	37	49	59
Of 100 persons, there lived to the age of 40....	20	30	43	52
Of 100 persons, there lived to the age of 50....	14	22	35	44
Of 100 persons, there lived to the age of 60....	9	15	26	32

By this table we see that where, in the sixteenth century, nine persons lived to their sixtieth year, thirty-two persons do so now; and if we take the average number of survivors for all periods of adult life, it will be found to be at the present time considerably more than double what it was three hundred years ago.

We can also conclude from this table that the total number of years over fifteen which men live through on an average, has rather more than doubled in three centuries, and that, therefore, from this cause alone, the amount of work done by each person before he dies is more than twice what it formerly was.

The above statistics are all taken from the records of the same place, and the same people, and the conclusions drawn from their comparison may therefore be regarded as reliable; the more so, since they are in perfect accordance with the results of the vital statistics of other countries, where such statistics have been kept for a sufficient length of time.

Thus, in England, the expectation of life, that is, the probable future length of life, of persons twenty years old, is stated to be at the present time about forty-four years, while a century ago it was rather less than thirty-four years; so that there has been an increase at the rate of ten years for a century; and it seems probable that, for the last three centuries, there has been an increase averaging about eight years for each century, in this expectation or probability; an increase which would lead us to about the same results, as regards the average length of useful life, as those deduced from the Genevese tables, namely, that it has more than doubled during modern times.

Our knowledge of the advance made as to the length of life, is of course more capable of statistical demonstration than that of the other benefits resulting from the application of science to the preservation and restoration of health; but if we admit reasonable conclusions, from circumstantial evidence, we will find that, in other respects, the improvement has been at least proportionate.

The shortening of the duration of sickness, and consequently of the

amount of time lost by each person from that cause, seems to be fully as great, in proportion, as the lengthening of life; more so, certainly, in some diseases.

In surgery, the improvement in the treatment of wounds, fractures, and dislocations, by which permanent disabilities are often prevented; the progress of conservative surgery, or that branch of the art by which limbs are preserved, which, without the exercise of peculiar skill, would have to be sacrificed; and other advances made by the profession, have done much toward the diminution of crippled and deformed persons in the community, as well as toward the preservation of life.

Without the instrumentality of medicinal science, many great enterprises would totally fail, or only succeed with extreme difficulty. Long sea voyages, for instance, which in former times often involved the loss of crews by disease, or the interruption of the voyage from the prevalence of scurvy, are now performed without a greater mortality than would occur among the same men on shore; and thus our knowledge of the world has been extended, commerce enlarged, and the ocean made a safe highway for civilized man, in a way that would, two hundred years ago, have been impossible, simply from the ravages of disease on shipboard. Many similar examples might be cited, which are, however, not needed for the establishment of the point here aimed at.

The consideration of the benefits conferred upon the community at large, and of the gain, in an economical point of view, to be derived from the cultivation of medical science, is not, it is true, necessary to turn man's attention to it. His greatest hopes and fears, his strongest feelings, are too much called forth by the sickness and danger of himself and of those around him, to allow him to neglect any available means of relief; and he will seek medical aid, and support medical men, even without giving a thought to the general utility and the economical value of their occupation.

In the care, however, of those animals which have been given into his dominion, and from whose labors he derives so large a part of his prosperity, it is to be feared that a sympathy for their sufferings and a humane regard for their welfare would be insufficient motives to induce him to attend properly to the treatment of their diseases, unless it could be shown that, by doing so, he increases his own wealth to an extent that fully compensates him for the expense and trouble thus bestowed.

There are, perhaps, some who fancy that the brute creation, living in accordance with natural instincts, or in obedience to some routine imposed on them by man, and destitute of that finer organization which in the human race is thought to render the system peculiarly liable to derangement, must be but little subject to disease; that their lives, with few exceptions, must pass through an even course, untroubled by sickness, and sink only when the lapse of years has weakened their vigor and brought them to the natural termination of their existence. Such is not the case, as far as is known, with any class of animals; such is certainly far from being the case with those which are under the care of man.

We often speak of the constitution of a horse, assuming him as the type of disease-resisting vigor and unfailing health; yet ample statistical reports in Germany, France, and England, have shown that the mortality of horses, in the prime of their life, is many times greater than that of man at a corresponding age.

This mortality among horses is, no doubt, for the most part preventable; and we have no reason for believing that, with proper care and skill in their treatment, horses would die much faster than men; for the number of annual deaths during the years of youth and middle life does not depend upon the absolute longevity of the animal, and might be as small in the shortest as in the longest-lived species.

The annual mortality among horses in their working years is about five per cent., or one twentieth of their whole number; and as the number of horses in the United States is about five millions, there would, at that rate, be a loss of two hundred and fifty thousand every year; and if their average value be taken at fifty dollars each, the pecuniary loss will amount to twelve and a half millions of dollars.

The mortality among oxen is much less than that of horses; while that of sheep is greater.

Besides this regular and usual mortality of domestic animals, they are, like the human race, subject to occasional visitations of great and extraordinary sicknesses. Such epidemics, when of a certain degree of virulence, are known under the name of murrains, and seem, from the earliest ages, to have been regarded as among the severest afflictions to which nations were exposed.

A murrain was threatened to Pharoah as a calamity, the nature of which was fully understood by him; and, in this instance, as has often been the case in subsequent murrains, the pestilence was to attack more than one species of domestic animals, it being foretold that, "upon the horses, upon the asses, upon the camels, upon the oxen, and upon the sheep, there shall be a very grievous murrain."

Homer relates that the pestilence which was sent upon the Grecian camp, first seized upon the domestic animals congregated there; and some of the most eminent writers of antiquity, as Hippocrates, Plutarch, Livy, and Virgil, speak of the murrains which seem, at various times, to have visited Greece and Italy.

In the fourth century, a murrain of great virulence devastated Europe, and may, perhaps, be reckoned among the causes which hastened the downfall of ancient civilization.

Unusual mortality of cattle occurred, from time to time, in different localities, during subsequent ages; and, in the eighteenth century, the occurrence of a murrain which, originating in northern Asia, prevailed for a series of years over a large part of Europe, roused the public mind to the necessity of the better cultivation of veterinary medicine.

In the present century, the various domestic animals have, in different regions, been subject, at times, to great mortality; but nothing has yet occurred of the nature of a general murrain. Nevertheless, the teachings of history make it evident that such a thing must be expected at some future period, perhaps remote, but, it may be, near at hand.

The amount of devastation committed by such an outbreak in a

country, a large part of whose wealth consisted of live stock, might be immense, and the loss would be especially felt if falling upon an animal like the horse, whose services are almost essential to the maintenance of every branch of industry.

There is, in general, no form of disease over which medicine seems to have more control than over great pestilences; for the prevention or cure of any one case, not only affects the individual chiefly concerned, but hinders an addition from being made to the intensity of the general pestilential action, and by so much checks the propagation of the disease and the virulence of its attacks.

Independently of the effect produced by the diminution of the annual mortality of domestic animals, we have to consider, so far, at least, as the horse is concerned, that which would follow the lengthening of the time during which they are maintained in a state of soundness and vigor. A horse is fed and cared for until he becomes old enough to labor, at an expense varying in different places, and which, for the United States, has been estimated to range from twenty to sixty dollars. For this outlay he makes return during his subsequent life; and the amount of the return made must depend upon the length of that life, up to the time at which he becomes unfit for work; so that, to render him of proper value to man, he should be maintained free from infirmity to the age when the inevitable operation of natural laws terminates his usefulness.

The horse attains to his greatest strength and vigor between the tenth and twelfth years of his life, but in too many cases he has scarcely passed, or arrived at that epoch, when he is already infirm, lameness or other disability having been brought on by injudicious management, or by neglect or maltreatment of some chronic disease.

That the natural decline of a horse's strength does not take place until a much later date than the period at which his usefulness is usually thought to terminate, has been amply shown, there being many instances of horses retaining their vigor after their thirtieth year, and some having been known to live to the age of forty and upward; the longest authenticated life of a horse in England or this country having been sixty-two years.

A writer in one of the English agricultural journals, who seems to have given particular attention to the prolongation of the working lives of horses, states as the ages of five horses in his stables, who were all serviceable animals at the time of his writing, the following numbers of years:

Thirteen, twenty-one, twenty-six, twenty-nine, and forty. He attributes their good preservation mainly to the care and skill exercised in shoeing them and in attending to their feet.

During the latter part of the eighteenth century, the want of judicious treatment of domestic animals, in health and disease, was seen with regret by many enlightened persons, and, among others, by the illustrious Buffon, who, in his work on natural history, after having treated of the horse, expresses himself on this point as follows:

"I will not here speak of the other diseases of horses, since to add to the history of an animal that of his diseases would be to render natural history too prolix. Nevertheless, I cannot finish my account

of the horse without expressing my regret that the health of this useful and precious animal is at the present time abandoned to the care, and to the often blind practice, of uneducated and ignorant persons. That department of medicine which the ancients called *veterinary* medicine, is now scarcely known, except by name. I believe, if some medical man were to turn his attention to this subject, and devote himself chiefly to it, he would soon be amply recompensed, and that he would not only acquire wealth, but, instead of being lowered in his profession, would become illustrious.

"This branch of the healing art would not be so difficult nor so dependent on conjecture as human medicine; for, since the food, the habits, the effects of the mind, in short, all acting causes, are more simple among the lower animals than with man, the derangements of their health should be less complicated, and consequently easier to diagnose, and to treat successfully. We must also take into account the great freedom with which we can make experiments, try new remedies, and thus acquire, without causing ourselves great anxiety, and without incurring odium, a large fund of this kind of knowledge, from which, in the way of analogy, we might draw conclusions useful even in human medicine."

The high authority of Buffon, and the zealous exertions of some of his cotemporaries, were much aided toward the attainment of the desired end by the great mortality among cattle which occurred during his time; and in the year 1761, a veterinary school was founded at Lyons, at the head of which was placed Bourgelat, a name celebrated in the history of veterinary medicine. In 1766 another school was opened at Alfort, not far from Paris, which, in the course of time, became a most useful and flourishing institution. Perhaps no better idea could be given of the condition and management of such schools in France, than to quote some passages from the account of the one at Alfort, by Mr. H. Colman, who visited Europe in 1843 for the purpose of examining the state of agriculture and agricultural institutions.

"This establishment is beautifully situated on the river Seine, near the village of Charenton, about six miles from Paris.

"The buildings for the different objects of the institution are spacious and well-contrived, and the grounds sufficiently extensive and judiciously arranged. Like other governmental establishments in France which have come under my observation, the institution is upon a grand scale, and complete in all its parts. The government of France, in a liberal manner, avails itself of the talents of the most competent men in every department, and of all the advantages which science and art can afford; and it spares no expense in the perfect execution of whatever it undertakes. It adds to all this, as is everywhere to be seen, a refinement of taste in the arrangement of the most ordinary subjects, which increases the expense only in a small degree, and which does not abstract at all from the solidity and substantial character of the work itself; but relieves that which would otherwise be monotonous, if not offensive, and often renders the plainest subjects attractive.

"The school at Alfort is designed to furnish a complete course of instruction in veterinary medicine and surgery, embracing, not horses

only, but all the domestic animals. A student, at his entrance, must be well versed in the common branches of education ; and a full course of instruction requires a residence of four years. The number of pupils is limited to three hundred. Of these, forty are entirely supported by the government. These are educated for the army, and are required not only to become versed in the science and practice of veterinary medicine and surgery, but likewise in the common business of a blacksmith's shop, as far as it is connected with farriery.

"The establishment presents several hospitals, or apartments, for sick horses, cows, and dogs. There are means for controlling and regulating as far as possible, the temperature of the rooms, and for producing a complete and healthy ventilation. There are stables where the patients may be kept entirely alone, when the case requires it, and there are preparations for giving them, as high as their bodies, a warm bath, which, in cases of diseased limbs or joints, may be of great service. There is a large college, with dormitories and dining-rooms, for the students; houses for the professors within the inclosure; rooms for operations upon animals, and for anatomical dissections ; a room, with a complete laboratory, for a course of chemical lectures ; a public lecture-room, or theater ; and an extensive smithery, with several forges, fitted up in the best possible manner. There are, likewise, several stands, contrived with ingenuity, for confining the feet of horses, that students may make, with security, their first attempt at shoeing, or in which the limb, after it has been separated from its lawful owner, may be placed for the purpose of examination and experiment.

"An extensive suit of apartments presents an admirable and, indeed, an extraordinary museum, both of natural and artificial anatomical preparations, exhibiting the natural and healthy state of the animal constitution, and likewise remarkable examples of diseased affections. The perfect examples of the anatomy of the horse, the cow, the sheep, the hog and the dog, in which the muscular integuments, the nerves, the blood-vessels, and, indeed, all the parts, are separated, preserved, and exhibited, by the skill of an eminent veterinary surgeon and artist, now deceased, who occupied the anatomical chair of the institution, display wonderful ingenuity in their dissection and preservation, and present an interesting and useful study, not to medical students only, but to the most ordinary, as well as the most profound, philosophical observer. I have seen no exhibition of the kind of so remarkable a nature.

"The department for sick dogs, containing boxes for those which require confinement, and chains for such as must be kept in the open air, and a cooking apparatus and kitchen for the preparation of their food, was spacious, well-arranged, and contained a large number of patients.

"Any sick animals may be sent to the establishment, and their board is to be paid at a fixed rate of charges; twelve *sous*, or six pence, per day, for a dog, and fifty *sous*, or twenty-five pence, for a horse, including medicine, advice, and attendance. In cases of epidemics, or murrain, prevailing in any of the districts of France, the best attendants and advice are sent from these schools, to assist in the cure, and espe-

cially to watch the symptoms and progress of the malady. In countries where large standing armies are maintained, and where, of course, there are large bodies of cavalry and artillery to be attended upon, as well as wagon horses for carrying the supplies, the importance of veterinary surgery is vastly increased; but in countries where no standing armies exist, the number of horses kept for use and pleasure, and of other domestic animals, bears a much larger proportion to the number of human beings than we should like to state without inquiry, and renders the profession highly important."

Other veterinary schools were before long established in different parts of France, and in various countries of Europe; in Germany, in England, in Russia, and in Italy. The veterinary college at London was established in the year 1791, under the charge of a graduate of the parent school of Lyons, and at the expense of a number of gentlemen who, upon becoming subscribers to the school, acquired certain privileges with regard to the medical treatment of their horses, in the event of their sickness.

The college received much encouragement from the medical profession of London, and a committee of some of the most eminent practitioners was appointed to assist at the examination of those of the pupils who became candidates for graduation, and to certify to their acquirements in case that they should be found properly acquainted with the principles of medical science and with the veterinary art. The associations of physicians with veterinarians, in such colleges, is one of the best assurances that the character of the education there given will be kept up to the high standard to which medicine has herself attained, and that the empiricism of a speciality will not be allowed to displace the philosophic spirit of true science.

Soon after the establishment of the London college, it received further encouragement by the appointment of veterinarians, as commissioned officers in cavalry regiments—a proceeding of great benefit to the service. The care of horses was the original object of the college, but an annual sum was given to it by the Royal Agricultural Society of England, to enable it to extend the field of its operations over the other domestic animals, whose diseases it has, accordingly, taken charge of; and such animals are sent from London and the neighboring country to the infirmary of the college, where, for a moderate charge, they are fed, housed, and receive veterinary attendance. The college has also received assistance from parliamentary grants.

In Germany, some of the veterinary colleges have, as a chief object, the education of veterinary surgeons for the military service.

In the United States, Veterinary colleges have been recently established. A veterinary institution has existed for some years in Massachusetts. In Pennsylvania, the Veterinary College of Philadelphia was incorporated in 1852, and put into operation during the present year. Four professorships have been established in it, namely: Of Materia Medica and Therapeutics; of Pathology and Practice of Medicine in Reference to Domestic Animals; of Medical Chemistry and Pharmacy; of Anatomy, Physiology, and Operative Surgery.

The College of Veterinary Surgeons of New York has also announced a course of lectures for the session of 1859–60; it has established

professorships of Veterinary Theory and Practice; of Veterinary Anatomy and Surgery, and of Chemistry; and has a Board of Censors, composed of some of the most eminent medical men in the city of New York.

A veterinary author, who stands as high as any who have written in the English language—Mr. Delabre Blaine—remarks, in his Veterinary Art, that there are three classes of persons by whom veterinary medicine may be profitably studied; first, by gentlemen owning animals, and taking considerable interest in their management; second, by medical men who design practicing in the country, or in small towns, where regular veterinary surgeons are not accessible; and last, by those intending to make veterinary surgery their profession.

The acquirement of veterinary knowledge by non-professional men is a thing not at all impracticable, especially in the southern part of the United States, where, as agricultural matters are often under the control of men of wealth and leisure, a very thorough and elaborate education might be given, with the particular view of fitting gentlemen for the management of everything connected with a farm or plantation.

One remark, however, should be made with regard to veterinary education, whether of amateurs, or of professional men: no branch of medical art can be usefully taught without first imparting some knowledge of that medical *science* upon which the art rests. The names of diseases, their most prominent symptoms, and the remedies used for them, may, indeed, be communicated; but that information, without the guidance of rules for correct reasoning on the subject, can only lead to a blind and mischievous officiousness. Those who would learn how to deal with the arrangements of the living body, should first have their minds properly trained by the study of some branch of natural science, and, being thus accustomed to recollect facts, and to view them as parts of a system, they are better fitted to acquire a knowledge of the structure and of the functions of the body; in other words, of anatomy and of physiology. It is not essentially requisite that this knowledge should be minute, but a certain amount of it must be acquired, after which the various modes in which the functions depart from a state of health, and the proper methods of remedying such departures, may be made objects of study.

A delicate question here arises: whether any knowledge short of the professional would be of practical use to any one? It seems to me that the only way of throwing light upon such a question is to attempt to answer it as far as human medicine is concerned, and to leave the conclusion thus drawn to be applied, analogically, to the veterinary art. The skill which the medical man applies to the treatment of difficult cases is not to be attained except by those who have devoted many years to its acquirement; but there is much that he does which he could teach others to do without burdening them with an elaborate and laborious course of instruction. In the surgical art, there is a special branch called minor surgery, which treats of such things as the proper mode of dressing wounds, burns, and scalds; of setting fractures, and reducing dislocations. Much of it is taught to, and practiced by, hospital attendants and medical students in the early part of their course of medical education. Any intelligent person could, in a few weeks, learn enough of this art to enable him to render great service

in cases which at present are neglected, or given over to the management of the ignorant and presumptious, either from the inaccessibility of regular surgical aid, or from an indisposition to have recourse to it.

It may not be impossible to establish a similar branch of the medical art. A great deal of medicine has been, and always will be, administered without the advice of a physician; in fact, it is the testimony of apothecaries that the greater part of the medicine sold is so administered.

If instruction as to the nature and proper use of the medicines most in the hands of the people were generally diffused, of course with some previous instruction concerning the human body, and its more common and simple diseases, the amount of medicine taken would be less, and the good effected by it vastly more certain.

Without attempting to intrude upon the serious duties of the physician, every educated man might be qualified to deal with those trivial affections from which the great harvest of quackery is reaped, and to render service to himself and others, when out of the reach of professional assistance. To do this, the knowledge possessed may be limited, but should be perfectly sound as far as it goes, should be derived from unexceptional sources, and be in no wise akin to that of those pseudo-medical works, of a popular cast, which are at the present day put forward in large numbers, for the edification of a credulous public.

Similar remarks may be applied, with still more force, to veterinary surgery and medicine. Domestic animals, in many parts of the country, must be so far out of the reach of regular veterinarians, or of physicians qualified to practice the veterinary art, that the only means of giving them the benefit of medical knowledge is by lodging it in the hands of their owners.

The mode of education of regular veterinarians is a matter of more settled character than the above. The colleges existing in England, and now going into operation in this country, are founded by the effort of associations, and sustain themselves, both from the fees of pupils and from those received for the medical treatment of horses and other animals.

A number of persons become subscribers of a small annual sum, each, toward the maintenance of a veterinary hospital, in consideration of which they acquire the privilege of consulting the veterinary surgeon of the establishment upon the proper treatment of their animals, upon the soundness of a horse that they purpose buying, and upon such other points as may present themselves; and when a horse is sick, they may send him to the infirmary and have him attended to, with no other expense than that of his keep at livery and of his medicines. The veterinarian should not, save in exceptional cases, be called upon to pay visits out of the hospital, but should remain at the establishment. A hospital thus established furnishes the means of clinical instruction for a school, which may afterward be attached to it. Professors of anatomy, physiology, materia medica, and chemistry, may, if necessary, be chosen outside of the ranks of veterinary practitioners, and students may be received on terms similar to those of medical colleges, and subjected to a course of study varying from two to four years. Much may be done in this way by private enterprise; but the

question arises, of how far such schools might hope for the support of a State, or of the federal government.

All forms of civilized government have made education, in some way, their care, and there would seem to be great propriety in this, since all experience tends to show that the prosperity of a community chiefly depends upon the education of its members. This is true, whether we consider that general diffusion of knowledge and of mental discipline, which enables the citizens of a free State properly to exercise their powers and to discharge their duties, that higher cultivation of a few, which fits them for the investigation of the laws of Nature, and for determining the scientific truths upon which the arts of civilization are founded, or that special training in the arts and professions, which qualifies men to do good in their respective callings.

Now, if the importance of the veterinary art, and all the advantages dependent upon it, be fairly considered, it will, I conceive, be found worthy of the extension of a helping hand to its struggling infancy, if not of a more permanent support.

Physicians and surgeons form a third class, to whom Mr. Blaine recommends, under certain circumstances, the study of veterinary medicine. It may be remarked of these that, beside the advantages that may result to themselves from the possession of such knowledge, they, as a body already possessed of weight and authority in the community, and able to make their influence widely felt, can bring about reforms which can hardly be effected by other agencies. To illustrate the point that there may be a flourishing condition of veterinary institutions, a class of educated veterinarians, and an extensive veterinary literature, and that yet those to whom the care of animals is chiefly intrusted may be comparatively uninfluenced by the progress around them, I would quote from Wilson's Rural Encyclopedia a portion of the article on Hippopathology, (the science which treats of the diseases of horses:) "Yet, in spite of the enormous bulk and the vast variety of our domestic hippopathological literature, in spite, too, of the stupendous additions to it which are made by French and German works of easy access, the science continues to be incredibly little known by the great body of the horse-owning community, and is still in a scandalous empirical condition, among a considerable proportion of country practitioners. Even if no books at all existed on the subject, a little common sense, expatiating on the analogies between the health of the horse and the health of man ought to rescue grooms and farmers from the absurdities and cruelties which many of them practice in the stable."

A wider diffusion, as well as a further increase, of veterinary information, is evidently required, and to insure its diffusion there is no better way than to have its precepts and practice enforced by a large and widely-spread number of persons, the correctness of whose knowledge on such topics the public are already prepared to admit. This is a thing which physicians are not qualified to undertake at present, although they could become so by means of some addition to the usual course of medical education. It has been remarked that "a good physician has gone three fourths of the way toward becoming a good

veterinarian, but he must go the other fourth to become a veterinarian at all."

As the medical sciences have not been limited in their beneficial results to the healing of the sick only, but have, by means of the knowledge of the human economy which they inculcate, thrown light upon all questions involving the physical well-being of man, so we are apt to expect that from the cultivation of veterinary medicine we will obtain guidance in many important matters which concern the physical state of domestic animals. Every question relating to their management, whether involving the condition of an individual or that of a race, is a question of the mode of action of physiological laws, and can only be satisfactorily answered by those who have made the physiology of animals their professional study.

The strength of this position will be readily admitted with regard to individual animals, and it may, I think, be shown that a necessity exists for a body of educated veterinarians, to take in charge matters that affect races and species of our domestic animals, rather than single cases.

Our domestic animals are, to a great extent, artificial productions, their most valuable qualities having been communicated to them by a kind of cultivation; thus breeds of horses have been produced far surpassing in size, strength, and fleetness, any animal of the species that exists in the wild state; the ox species has acquired in different races great capabilities of producing flesh for the butcher, or milk for the dairy; the sheep is clothed with a fleece more valuable for human use than that worn by his wild progenitor; and all valuable animals exhibit marked alterations from the original type of the race, which have been produced by human care and management. The extent of this change varies much with different breeds, and its importance is testified to by the high prices commanded by those animals in which it is most strongly marked.

Few improvements contribute as much to the wealth of a nation as these. The expense of feeding and of caring for an animal of good breed is but little more than that required for a very inferior one, and the profit derived from it, whether in the shape of labor, of flesh, of wool, or of milk, is often very different in the two cases. A farmer may raise a horse that will command one thousand dollars in the market, or one worth less than a twentieth of that sum, and spend nearly the same on either animal. In view of the strong motives which exist for raising the finest animals only it may seem a matter of surprise that there are so many bad ones, and that, especially among horses, where good quality is of such great importance, the general standard should not be higher. There is, however, a want of certainty and of permanency about these improvements, which arises from their artificial character. there is a constant tendency in the race to return to the condition of Nature, and, where measures are taken to prevent the loss of some one of its characteristics, it sometimes happens that those very means hasten the destruction of some other, or diminish very much the vitality of the race.

The maintaining of good breeds becomes thus a struggle between Nature and art, and the art is one that requires peculiar skill and

knowledge to manage with the best results; and while the intelligence and care of a number of enterprising persons, who have been stimulated by large profits, and possessed of considerable means, have done much for the improvement of breeds of animals, the success thus far attained has been attended by a host of failures and disappointments, and, in some cases, where the greatest care and expense has been bestowed, it is maintained, by good authorities, that a positive degeneracy has taken place.

The difficulties in the way of making a breed of animals just what we want it to be, and of maintaining it in that condition, are of a complicated character, and demand for their correct solution the attention of those who can regard them from a scientific point of view, and whose daily studies and experience relate to the animals which they concern.

ADMINISTERING MEDICINES TO DOMESTIC ANIMALS.

TRANSLATED AND CONDENSED FROM AN ARTICLE BY DR. WAGENFELD, OF DANZIG, PRUSSIA.

Animals being unwilling to take medicine of their own accord, it must be administered by force, except when mixed with agreeable substances, for instance, with oats for the horse, and with meat or sugar for the dog.

THE HORSE may receive medicine in different forms; first, as a *powder*, This is to be mixed with short fodder, especially oats, with a portion of bran, which should be moderately moist, because he would otherwise blow away some of the powder with his nose. Though this mode is convenient, it can only be employed to a limited extent, as the horse will not eat his fodder if it be mixed with medicine of a considerable odor, or if his appetite be much impaired. Secondly, as a *drink*. For instance, several salts and acids, also insoluble powders, as red bale. But here, likewise, a difficulty becomes apparent. The horse, from an absence of thirst in certain diseases, drinks little or nothing, so that the medicine is not taken in the quantity desired. Thirdly, as an *infusion* or *potion*. This form deserves to be more fully considered, as many horses have been lost in consequence of potions being administered. If, for instance, a horse is suffering from colic, a potion is usually given, sometimes several of them, and even veterinary surgeons resort, especially in this case, to infusions through the mouth. Though it is known that the infusion is not wholly without danger, because part of the liquid might easily get in the windpipe, yet the injury that may result is not sufficiently considered, even by many surgeons.

The application of infusions, especially in colics, has been recommended, because a rapid remedy is desired, which is most likely to be attained by mixing the medicine with a certain quantity of liquids, and bringing it thus immediately in connection with a large surface of the stomach and the bowels. Though these advantages are not to

be denied, yet the incidental injuries are of so serious a nature that it becomes the duty of a surgeon to consider the propriety of giving infusions, when an electuary could be conveniently substituted. This is a medicinal jelly, to be spread on the tongue of the horse, for swallowing. The stomach always contains a certain quantity of humidity, serving to thin the electuaries, so that they will very soon show their effects, though perhaps not quite so rapidly as an infusion. When I commenced my practice in veterinary medicine, some thirty years ago, I had often to treat horses suffering from colic. I always administered infusions, adapted to the circumstances of the case, giving them myself, and using the utmost precaution. A cure usually resulting, I saw no reason to abandon this mode of treatment. Yet, in the course of time, I lost three patients of this sort. They were cured of colic, it is true, but the day following, or somewhat later, an inflammation of the lungs ensued, causing the death of the horse. At that time I did not see clearly enough the connection existing between colics and inflammation of the lungs ; still, I refrained from that moment from applying similar infusions, and have not made use of them for the last twenty-five years.

In many books, otherwise reliable, it is stated that colics of the horse are frequently followed by inflammation of the lungs—an observation perfectly correct ; but the cause and effect of this symptom, which, on infusions being avoided, is of rare occurence, have neither been explained nor even anticipated.

It has been said that well-informed veterinary surgeons know very well the danger often connected with giving infusions, but none of them had ever, by direct experiments, disseminated a clear understanding on this subject until Mr. Günther, Director of the Veterinary School at Hanover, did so. Yet it is to be regretted that his investigations have not come to the knowledge of every owner of horses. As long as horses were cured, infusions were principally applied, and this has been the practice for a long time, perhaps as far back as history reaches.

Buttermilk given to horses for medicinal purposes has proved fatal, and hence originated the belief that it was poisonous to them—a belief which prevailed in many parts of the country, if not among surgeons, yet to a great extent among the people. Mr. Günther's experiments, however, demonstrated in what really consisted its poisonous quality.

Seven and a half pounds of buttermilk were administered to a healthy horse, as an infusion, through its mouth. The animal, immediately after, became restless, breathed heavily, opened violently and wide his nostrils, and exhibited, in the course of the day, symptoms of a severe inflammation of the lungs. The attacks, gradually increasing in violence, killed the horse in forty hours. On examination, the lungs were found to be inflamed, but the stomach and bowels, together with all other parts of the body, were in a healthy condition. To another, six and a half pounds were given, through a leather pipe, into his stomach. The animal continued, in every respect, healthy, and after being purposely killed, at the expiration of fifty-four hours, no disease was discovered in any part.

From both these experiments it is evident: first, that buttermilk is

not poisonous for horses, if it goes into their stomachs; secondly, buttermilk may produce a fatal inflammation of the lungs, if the horse, on its being administered through his mouth, swallows it in a way that part of it enters the windpipe and the lungs themselves.

The stomach only is destined for the reception of solid and liquid substances, the lungs being capable of enduring, without injury, none but the delicate food of the atmosphere.

Mr. Günther made an opening into the windpipe of the horse, thus bringing eight ounces of buttermilk through the windpipe into the lungs. Immediately after, the horse became restless, dropping its head, and tripping with its feet; it breathed rapidly, did not lie down during the night following, refrained from eating, and exhibited all the symptoms which were observed after the first infusion through the mouth; consequently, a portion of buttermilk had entered the lungs. After a lapse of thirty-eight hours the animal was killed, when the lungs were found to be inflamed, though all the other organs were in a healthy condition—corresponding with the first experiment.

Not only buttermilk, however, may create an inflammation of the lungs, on being administered as an infusion through the mouth, but every other liquid, even tepid water, may have the same fatal result.

Again, a horse received eight ounces of oil of turpentine through an opening into the windpipe. Immediately after, it began trembling and staggering, opened rapidly and wide its nostrils, breathed fast, &c. On its body being opened, the lungs were found to be swollen and inflamed, as in former experiments.

Another horse received two pounds of brandy as an infusion through his mouth. Soon he began coughing, breathing rapidly, &c. This case was observed for twenty-two days. He recovered to some extent, and ate tolerably, but coughed much, had a quick pulse, looked always melancholy, and grew lean. On opening the body, the lungs were found to be inflamed, all the other parts being healthy. A portion of the brandy had evidently gone the wrong way, that liquor not being injurious to a horse when in the stomach itself.

An ounce of oil of turpentine, and a like quantity of linseed oil, were administered to another horse, through an opening of the windpipe. He forthwith began staggering in his walk, trembled, threw himself on the floor, and sprang up again immediately; but after six or eight hours became more quiet, took a little food, coughed, and, in the course of the six days following, exhibited only a quick pulse, coughed often, and did not lie down, seeming otherwise not to be very sick. Six days and a half after the infusion was given, the horse was killed. Part of the lungs was found to be inflamed and obdurated. This case proves that even a small quantity of an extraneous liquid, penetrating into the lungs, is capable of producing a dangerous condition. How easy is it for such a small quantity to get into the windpipe, when given as an infusion! Even when the horse does not fall immediately, the consequences may still be pernicious.

The application of two ounces of brandy through an opening of the windpipe was accompanied by the same bad effects as in the former experiment.

Another horse received three-fourths of a pound of well water into the windpipe. Much of the liquid was ejected by coughing, but he continued to cough, and grew lean, though eating heartily. When he was killed, some sixteen days after, parts of the lungs were found to be obdurated, and therefore inflamed. Such is the delicacy of the lungs, that they are not even capable of enduring water without injury.

Examining why infusions, chiefly as to the horse, may become so dangerous, Mr. Günther arrives at the following conclusions: The horse, in consequence of his head being forcibly raised, is frightened, and in this involuntary position must feel but little disposed to swallow; he is averse to receiving a liquid which he usually finds disagreeable; in consequence of the coughing caused by the operation of giving the infusion, the flap of his throat is opened, through which some matter might easily get into the windpipe thus exposed; the danger is further increased, if the entire space of the mouth be at once filled with the infusion; and the pulling out of the tongue, which is a common practice, renders deglutition more difficult, of course increasing the probability of a portion taking the wrong course. Should he be suffering at the time from inflammation of the lungs or throat, the infusion will be so much more dangerous.

In consequence of the results of these and other experiments, the practice of giving infusions has been banished from the Veterinary School at Hanover, and most of the veterinary surgeons throughout the kingdom, ranking among the best in their profession, have also discontinued it.

It may be replied, by some, and even surgeons among them, that they often administered potions without having experienced any injuries—an assertion perhaps correct to some extent; but injuries have doubtless been done, even without the operators being aware of them. There are frequent cases in which an infusion will not immediately result in a serious disease, and after the horse has been relieved of his original sufferings, the owner is satisfied. Yet, if coughing should continue, perhaps for months, if the animal should have a bad breath, and if he should grow lean, some persons may attribute such symptoms of lung disease to other causes than the true one—the infusions formerly given. It is, nevertheless, true, and many horses having so called "rotten lungs," owe them to infusions, even if they had been given long ago. If I may be allowed to draw inferences from my own experience, I must contend that infusions are, in most cases, fatal, and always dangerous.

That infusions given through the nose are far more dangerous than those through the mouth, is self-evident. It often happens that the horse thus treated will suffocate on the spot, and generally will die, sooner or later, of disease of the lungs. Yet, though this practice may not always be followed by fatal consequences, it will in the majority of cases, as my own experience would prove.

In fatal cases through either of these modes of administering infusions, I always found the pituitary membrane of the flap of the throat, of the windpipe, and even that of the lungs, to a great extent to be bluish-red, but more frequently very dark-yellow, almost blackish.

Aside from the evil consequences resulting from infusions, there are unavoidable inconveniences. Several persons are required to perform the operation, a portion of the medicine is apt to be lost or wasted, so that the quantity contemplated does not get into the stomach; the bottle is liable to be broken by the teeth, so that there is danger of the horse swallowing some of the glass; and the clothes of the persons engaged are more or less soiled. That infusions in diseases of the organs of respiration are a great deal more dangerous, has already been mentioned; but they must be absolutely censured in cases of tetanus, swollen tongue, inflammation of the brain, &c.

Fourthly, in the form of *electuaries:* These are prepared by converting the medicinal substances, for the most part powder, into a paste, by means of some agglutinant and cold water. Formerly, it was almost a general custom to employ honey, sirup, elderberry-jam, or some other sweet substance; but at present flour is preferred, inasmuch as these sweet substances cause the electuaries to be rather expensive, and also impart a tendency, in warm weather, to ferment and become acid. In some cases, for instance, inflammation of the throat, or lock-jaw, honey may still be used, as the animal will be more inclined to swallow the electuaries when seasoned by this addition.

Almost every medicinal substance, liquid as well as powder, may be made into jellies, or electuaries. Thus, if it be desired to prepare oil of turpentine, it is first mixed with the powder, receiving afterward some flour and water, so that it becomes a jelly simply by being stirred. Rye-flour is best for this purpose; but wheat-flour, or even groats, may be used. In the latter case, the jelly is less convenient to administer. The amount of flour is not a matter of importance, as adaptability alone should be considered, the quantity being proportioned to the amount of the medicine itself. If there are many salts, for instance, Glauber's, more flour will be required than if the medicine were to consist of powders made of seeds, roots, or worts. Some electuaries, after standing, become too thin, on account of the salts being dissolved, in which case they should be mixed with the requisite quantity of flour. Again, if powders are employed, the electuaries gradually become too stiff and crumbling, when water should be added. By flour or water, according to circumstances, the electuaries may always be given the form desired. A proper consistency would be such that the jelly will not flow off the spatula, below described, nor fall when the instrument may be reversed. Any person may prepare the jellies, after having procured the requisite medical substances.

The jelly may be applied with the hand upon the horse's tongue, which should be pulled to some extent out of his mouth. A preferable mode, however, is by means of a wooden spatula, the blade of which should be from two to two and a half inches long by one and a half wide.

In administering the jellies, one person places himself at the left side of the horse, and seizes the halter with the noseband, so as to hold ts head steady; or this object may be accomplished by one hand taking hold of the back of the nose, while the lower jaw is kept by the other. A second person, standing on the right side, draws out with his left hand the tongue of the horse, and with the spatula applies the

jelly to the back part of it, when the tongue is immediately set free. The horse commences a chewing movement, endeavoring, in this manner, to get rid of the disagreeable medicine; in which, however, he does not succeed, as he cannot spit. In consequence of the chewing, &c., a great deal of saliva is produced in the mouth, thus thinning the jelly; and shortly after he is seen to swallow. Should both his mouth and tongue remain still, the broad end of the spatula is brought across the fore-part of the mouth and turned like a twirling stick, by which he is forced to chew and swallow. It is not necessary to hold up the head of the horse after the performance, for if the jelly is well prepared it will adhere to the tongue.

By the application of jellies, almost every other form of medicine may be dispensed with, and all danger avoided. But little practice will be necessary to perform the operation well. For a series of years, I have been in the habit of using this mode almost exclusively, finding that my patients do better than with infusions.

Fifthly, as *pills*. With the exception of jelly, this is the best form of medicine. The horse receiving the pill, which is not chewed, wholly and without loss into his stomach, the doses to be applied can always be given accurately, which is of great importance, especially where a powerful effect is desired. Even the most disagreeable medicine must be swallowed, when administered in the shape of pills. They are usually made of several substances, which, by means of an agglutinant, such as flour, black soap, &c., can be readily formed, without adhering to the hands or changing their shape. This should be oval, of about three-fourths of an inch in diameter, from one to one and a half inches long. If too small, they are liable to get between the molar teeth; if too large, they are apt to remain in the throat.

To administer the pills properly, will require some practice. As the horse usually tries to resist, his position in the stall is reversed. Then his tongue is pulled out by the left hand toward the right side, and the pill, placed at the end of a pill-stick moderately pointed, and of the size of a finger, is introduced into the mouth, and deposited upon the back part of the tongue, after which the tongue is immediately let loose. Should the horse not at once swallow the pill, he should be given some water to drink, or a light slap on his mouth, in consequence of which he will be scared, and thus swallow it. Precaution should be used, not to injure with the stick the palate or other portions of the back of the mouth.

It is better to give these pills merely with the hand. The tongue is pulled out, as above, the pill is taken between the tips of the fingers of the right hand, and, by moving it along the palate, brought upon the back part of the tongue, which is immediately let loose, care being taken to prevent injury to the operator from the molar teeth of the animal. The hand, therefore, should be kept in the middle of the cavity of the mouth.

The "pill-stick," a wooden instrument, similar to a syringe, is well adapted for giving the pills. Within a cylinder, there is a stick about the size of a finger, and of the same length as the tube, having a handle at the end. At the other end, the instrument, being thicker than at the longer portion, is provided with a hollow, as a convenient

receptacle for the pill. The tongue is now pulled out, the instrument containing the pill introduced into the mouth, and the rod, which has previously been drawn backward, is pushed in, so that the pill is forced into the mouth. This method is easily operated; and neither the horse nor the hand can be injured. To facilitate the entrance of the pill, it may be moistened with oil, soap, or even with water.

In some diseases, pills do not seem to be applicable, for instance, in colic, as they require too long a time to dissolve in the stomach. What duration may be necessary to reduce them to a liquid state, I do not know; neither am I aware that any experiments have been made on the subject.

In case the pills become old, and therefore hard, they should not be given, for it is to be feared that they may not sufficiently dissolve, but pass off undigested.

Beside these, there are several other modes of administering medicines; thus, liquids may be given by opening an artery, or by inserting an elastic tube through the mouth and throat immediately into the stomach. None of these latter methods should be attempted, however, by the unprofessional operator.

Cattle.—With this species of animals there is no difficulty, nor is there scarcely any danger in giving medicines; which, as in the case of the horse, may be administered in different forms:

As powder, they may be given when mixed with crushed tubers, among malt dust, groats, oats, &c.; or, as a mixture, with the drink. Here, too, as was remarked of the horse, this method is rarely employed, for substances of an intense odor or taste are usually refused. Some liquids are taken, for instance, vinegar and other acids, if mixed with their drinking water. Pills and electuaries are rarely given to cattle, and, indeed, they may be generally dispensed with. On the other hand, infusions deserve the preference with cattle, being quite the reverse as to horses. The liquid is given with a common beer or wine bottle. For this purpose, the mouth of the animal is raised and opened a little by means of the fingers, after which the neck of the bottle is brought in, either from the right or the left side. So simple is the operation that it requires no further description; yet it would seem to demand precaution, as a mistake committed in applying it might result in a disease of the lungs. If possible, the medicine should be given when the animal is standing, and not when lying down, though, in the latter case, hardly anything can be feared, if the necessary caution is employed. The head should be held horizontally; if it should incline sidewise toward the breast, the swallowing is not only made more difficult, but part of the liquid may be liable to get into the windpipe, causing coughing and perhaps still worse accidents. Furthermore, the mouth of the animal should not be held up too high; it is sufficient that the mouth be kept a little higher than the cavity of the throat, so as to give but a small descent for the infusion. If too high, a portion of the liquid may get into the windpipe. It is advisable to give a third or half the contents of the bottle, and then to wait until after it is fully swallowed before more should be offered. In inflammation of the throat and lungs, or especially in diseases of

the lungs, particular attention must be paid to the giving of medicines, which ought always to be administered in small portions.

Sheep.—It is still easier to administer medicines to this species of animals than to cattle; beside, a single sheep rarely becomes the object of medical treatment. To give medicines repeatedly to whole flocks is hardly practicable. Fortunately, the sheep seldom abhors even such remedies as have a bad odor or taste; it takes them voluntarily. The usual form is by licking. A pulverized medicine, (sometimes with the addition of pine oil,) mixed with an adequate quantity of groats, oats, or kitchen salt, is laid before the sheep, by spreading the mixture equally in long troughs. It may occur in this mode that some of the sheep will lick a greater portion than they should, while others consume little or none. This is, indeed, an evil, perhaps unavoidable; yet there is no great reason to fear that a sheep will thus be permanently injured, as the opportunity only occurs at long intervals. If it be desirable to give medicine to a single sheep, it is best administered in the form of an infusion, or even as electuaries. Some remedies may also be given in drinking water.

Swine.—Medicines, in many cases, may be given to swine in drinking water, or among the fodder. An emetic, for instance, may be administered within a potato made hollow, or in a dumpling. In doing this it is presumed that the hog has not yet lost its appetite; in all other cases force must be employed. But none of our domestic animals show so great an opposition to compulsion as the hog. Its violent screaming on being taken hold of, and during the performance of the operation, increases the liability of a portion of the medicine to get into the windpipe, thus causing all the incident evils.

The medicine should be made into an electuary by means of flour, adding honey so as to make it agreeable to the hog. This jelly should always be thinner than that destined for the horse, its consistency being about that of sirup. A small spatula should be used, by which to spread it on the tongue and palate. In many cases it is hardly avoidable to give liquids, when great difficulty is experienced, but it must be overcome as well as possible. To secure the hog, requires the assistance of several resolute persons. The animal is shoved with his hind-part into a corner, where it must be kept tight, and if possible placed on the hind-part. A cudgel is then brought, in an oblique direction, into its mouth, which is opened in consequence of its screaming. By the insertion of this cudgel, (or a short, thick piece of rope,) the mouth of the animal is kept open. Another person then pours the liquid with a spoon (perhaps best of tin) into the mouth, after which the cudgel is immediately removed, so as to facilitate the process of swallowing. This operation is repeated until the quantity of medicine required has been given. In using the spoon, the interval during which the hog does not scream must always be taken advantage of. In many cases the liquid may be given in a less violent way. By continually scratching and rubbing the back of the hog in a gentle manner, it will usually become quiet and lie down. During this soothing process, a corner of the lip is drawn backward from the cheek, and the liquid poured in through a thin neck of a bottle, or by a spoon. Pills and stiff jellies are not suitable for hogs.

THE DOG.—This animal is endowed with such a fine sense of tasting and smelling that he does not willingly take a medicinal substance ; yet an emetic may now and then be given by putting it into cakes or meat. Emetics may also, in a dry state, be placed on its tongue. Pills are fastened at the top of a round piece of wood, or of a quill, and thus inserted deeply into the mouth. Liquids are poured into the opened mouth, or are still more easily given by raising the nose of the dog, taking hold of one of the corners of the mouth, and drawing it up and sidewise, so that a kind of pouch is formed for pouring in the liquid, which will thus enter through the openings between the teeth. This does not require any particular precaution, as the dog will not be liable to swallow the liquid the wrong way.

ACCLIMATION AND DOMESTICATION OF ANIMALS.

BY DR. B. F. CRAIG, OF WASHINGTON, D. C.

There is a matter of very wide interest which, like those spoken of in a preceding article, requires, for its successful prosecution, to be put in the charge of educated veterinarians ; and, as a preliminary to the consideration of it, I would ask leave to quote from a lecture delivered by Daubenton, the celebrated collaborator of Buffon.

"The object of veterinary science is to set forth the proper methods of perpetuating among domestic animals those good qualities which they have acquired by means of the culture which we have bestowed upon them, and to endeavor to increase still further their useful characteristics. It should also aim at reducing to the domesticated condition those wild animals which promise to be of service to us by means of their labor, or of their useful products.

"There are many animals of foreign countries which might be very useful to France, if they were once naturalized there.

"It is as practicable to tame the zebra as to have tamed the wild ass and the wild horse. If the tapir were naturalized in France it would furnish, not only a new kind of butcher's meat, but an additional article of commerce. There are many animals in America whose flesh is very good food, such as the peccary, the cariacou, the Guinea pig, the agouti, the akouchi. There are, in that country, armadillos, whose flesh is as white and as good as that of a sucking pig. Attempts should be made to introduce all these animals into France, and to reduce them to the condition of domestication.

"The investigations of veterinary economy need not be confined to quadrupeds, but should be extended to other classes of animals, and to

birds. We might introduce into our poultry yards the greater and the lesser bustard. The ruddock and the pilet, the grouse, and especially the moor-cock, would make very good poultry."

After speaking of certain other birds, he goes on: "Why should certain fishes be confined to particular seas and lakes? Is it not practicable to naturalize, in the running waters of France, the umber, which is found, at present, only in the Lake of Geneva, and the lavaret, which is confined to the Lake of Bourget, and to that of Aigue-Bellete, in Savoy.

"I have dwelt upon the establishment of the complete veterinary art in order to show that, from its relations with natural history, still greater benefits may be derived than are now got from its relations with medicine. Those animals yet untamed, or those known only in foreign countries, which we can justly hope to make useful to ourselves, should be found out, and placed in the hands of veterinarians to be tamed and domesticated, and to be broken into those habits which we wish them to acquire."

These paragraphs suggest considerations of greater importance than many would at first sight be disposed to accord to them, and open a subject where discussion might very well occupy an entire volume, but which, from its necessary connection with veterinary science, may, with propriety, have its outline here given.

Of all the arts by which man has acquired dominion over Nature, that of the domestication of animals is one of the most interesting and most important, and perhaps of all others has the most curious history.

Other arts have been, with various periods of rest, and even of retrogression, pretty constantly progressive during the period of man's existence upon the earth; and at the present time we have, it has been remarked, with regard to most of them, not only the accumulated results of previous progress, but an accumulation of progressive motion, which is carrying us forward, by a sort of *vis momenti*, in the path of improvement, each change for the better disposing us the more to seek for and to accept further change.

The domestication of wild animals, which much necessarily have been one of the first steps of man toward civilization, seems to have been, at some period anterior to recorded history, carried to a certain point, and to have remained almost stationary ever since, until the long absence of progress has made the very idea of progress difficult to be received. When the natural history of the horse, of the ox, of the sheep, and of most other domestic animals, is examined, they are found to have been originally natives, not of the regions in which they are found now in the greatest perfection, but of the continent of Asia, where, in the primitive seats of the human race, they have been reduced to tameness, and from whence they have been carried, as companions of man, over the rest of the now inhabited world. Although the different beasts of burden—the horse, the ass, the various species of ox, the camel, the East Indian buffalo, and the elephant—have doubtless been tamed at different periods of time, yet the period at which any of them was first domesticated is too far back for a record of it to have been preserved; and even among animals which are valuable only for their flesh, or for their skins and fleece, hardly a species can be found which

has been domesticated in modern times. Nor have the advantages, often not inconsiderable, that a country derives from the wild animals suitable for food which are found within it, been much improved on by artificial means, although such beasts, birds, and fishes, require little care beyond that attending their first transplantation.

That there are no animals capable of useful domestication except those which have been tamed by our ancestors, is hardly to be imagined, whether we form our opinion from a general view of the subject, or from a closer examination of facts. It is quite certain that there are those now domesticated which may, with great propriety, be carried to places in which they are, as yet, unknown; and, finally, it seems highly probable and reasonable that man may assist Nature in effecting the distribution of wild animals over the surface of the earth, and may bring about the general spread of the valuable, as well as the extermination of the noxious species.

The agitation of the question of the acclimation and domestication of new animal species, by Daubenton, Buffon, and others, has been followed by some advances in later times. In 1849, a report was made to the Minister of Agriculture of France, by Mons. J. Geoffroy St. Hilaire, upon the naturalization of useful animals, which was published, and produced the effect of calling increased attention to the subject. In 1854, a more extended work on the subject was published by the above-mentioned eminent savan, and the same year saw the establishment, in France, of the Zoological Society of Acclimation.

This society has been distinguished from its very commencement for the activity and the success of its operations; and, while we must expect many years to pass before the fruits of its labors can be reaped, there can be little doubt but that it will, in the course of time, contribute greatly to the prosperity of the human race, and to the true glory of the country in which it had its origin. An idea of the character of its labors may, perhaps, best be communicated by giving an account of a few of the objects toward which the attention of its members has been directed.

The introduction into Europe of useful animals, already domesticated in other parts of the world, would naturally be one of the first enterprises; and among such animals those of the llama tribe of South America, which includes the llama proper, the alpaca, and the vicuña, have particularly engaged the attention of naturalists.

These animals, which are the only beasts of burden indigenous to the American continent, inhabit the lofty table-lands of the Andes, where they breathe a highly rarified atmosphere, often endure intense cold, and live on a very scanty vegetation. They are valued by the people of Peru, and of the neighboring countries, for carrying burdens, for their milk, for their flesh, their skin, and their fleece; this latter, and especially that of the alpaca, is not only in use for domestic manufacture in the countries in which it is produced, but is also, as is well known, a very important article of commerce. The acclimation of the llama and alpaca, elsewhere than on their native soil, seems to be opposed by a peculiar obstacle, arising from the fact that not only is the temperature of the air in which they live altered by their transplantation, but also its condition as to density, so that the most appro-

priate course would seem to be to plant a colony of them on some lofty mountain or table-land, whence they might gradually spread downward into the adjoining plains. Experience, however, has shown that the pliability of the animal constitution enables the llama to thrive well in several European countries to which it has been carried, even in the low plains of Holland.

The naturalization of the llama in Europe was strongly recommended by Buffon, and many animals have already been introduced in private parks and menageries. It may, however, be reserved for the Society of Acclimation to distribute them to a useful extent.

An animal which resembles the llama in the character of the country of which it is a native, and in the variety of the uses to which it may be put, is the yak, of Tartary and Thibet, otherwise known as the horse-tailed ox, or the grunting ox, the *Bos Pœphagos* of Ælian. This peculiar species of ox is found among the lofty peaks and plateaus of the Himalayas, in certain parts of Tartary, and in the north of China. It is called by the Chinese the washing ox, from its fondness for entering the water.

The yak combines in itself many of the characteristics of different classes of animals. It has the general form of the ox; in some points of its configuration, in the character of its tail, in its gait, and by its swiftness, it resembles the horse; it has the fleece of the sheep; the sure-footedness and activity of the goat; and, lastly, the voice of the pig, or rather a deep grunt resembling that of the pig, whence, doubtless, its name of yak. The yak supplies the place of all the above-mentioned animals in countries where hardly any other domestic animal is known; it is used under the saddle, employed to carry burdens, and to draw the plow and the cart, is valued as a source of milk, for its abundant fleece, out of which a serviceable and water-proof cloth is spun, and for its flesh when dead.

The tail of the yak is particularly noticeable for its size and beauty, and has, in certain Asiatic countries, a symbolic importance attached to it as an emblem of power and grandeur. The yak-tail was the ancient standard of Turkish chiefs and kings, although, by the migration of that people westward, the name of the emblem has been changed to the horse-tail, those by whom it is now used never having seen, and perhaps never having heard of, the animal which their forefathers honored so much.

About the time of the establishment of the Society of Acclimation, a troop of yaks was sent to France by Mons. de Montigny, the French consul at Shanghai, who had them brought to him from the northern parts of the Chinese empire. On their arrival in Europe, some of them were sent, under the charge of the Society of Acclimation, to the most cold and mountainous regions of France, where they are said to be doing remarkably well.

While thus bringing about the introduction of the domestic animals of foreign countries into Europe, the society has not left unattempted the great enterprise of the taming of animals never before broken to human uses. The most favorable subjects for such attempts are to be looked for among those genera of animals, some species of which have been already domesticated. Now, the horse genus consists of six spe-

cies, three of which are natives of Africa, and three of Asia. None of the African species have been domesticated, while the Asiatics have tamed two out of the three found on their continent, namely, the horse proper, and the ass. Very recently a new animal has been brought from Asia, which is held to be another and distinct species of the horse genus. Passing over, for the present, the African species, we find the yet untamed animal of the Asiatic steppes to deserve, and to have received, particular attention from those having in view the domestication of new races. This, the *Equus Hemionus* of naturalists, the dziggüetai of the Tartars, has been but little known until recent years. It is a denizen of barren plains, where it gleans a sustenance from scattered patches of vegetation, passing with great swiftness from one place to another in search of food and water. It is wary and timid, and its great fleetness, in which, according to the testimony of Pallas, and of others, it surpasses all other quadrupeds, secures it from beasts of prey and enables it easily to outstrip the horses and dogs of the hunter.

The Tartars, who are fond of its flesh, sometimes kill it by ambush and stratagem, and sometimes secure it by surrounding it by a circle of hunters, after the Asiatic fashion. The form of the Hemionus is strikingly characteristic of an animal made for swift running, having the various points of figure which distinguish the racing or blooded horse, a figure which is produced in the horse by the efforts of art and by careful breeding, but which belongs to the Hemionus by Nature. Among such points may be mentioned, the large angle formed at the junction of the head and neck, which, by avoiding an abrupt bend in the air passages, enables the breath to be drawn with greater ease and rapidity than it could be otherwise; the horizontal position of the neck, which throws the center of gravity of the body well forward while in the act of running; the long and straight body, somewhat higher before than behind; the powerful haunches and the flat limbs, in which the tendons are large in proportion to the bones.

The Hemionus is supposed to be the animal which, under the name of the wild ass, is spoken of in the following terms in the Book of Job: "Whose house I have made the wilderness, and the barren land his dwellings. The range of the mountains *is* his pasture, and he searcheth after every green thing."

It is, of course, somewhat difficult to capture alive an animal of such exceeding swiftness, and which keeps far aloof from the habitations of man; nevertheless, through the influence of the French consul at Bombay, a few of them have been taken in the deserts of the north-western part of Hindoostan, and sent to France, where they have been found to be quite docile as well as hardy.

An animal which occupies a much humbler position in the scale of creation than any of the foregoing, but whose apparently insignificant labors are nevertheless of great importance to man, has attracted considerable attention from the Society of Acclimation. Beside the silk-worm of the mulberrry, or *morus multicaulis*, there exist in Eastern Asia species which live on the leaves of various other trees, such as the oak, the chestnut, the *ricinus communis* or *palma Christi*, &c. It has been thought highly desirable to introduce into France, silk-worms

that can be fed on the leaves of plants which are now abundant, and much progress is said to have been already made toward the naturalization there of those of the oak and of the *ricinus communis*.

The deficiency of animal food among the population of France has induced the Society of Acclimation to aim at the introduction of various animals whose flesh is suitable for human use. Some of these it is proposed to domesticate, and others to naturalize in a wild state, particular endeavors being made to select those animals which would inhabit places not suitable for cultivation, and live on vegetation which is not used by man nor consumed by other species of game.

The variety of animals which it has been proposed to acclimate for such purposes is, as may be expected, very great, and some of these possess interesting peculiarities of structure or of character. The South American tapir is a quadruped of considerable size, which resembles the hog, by its general form and by its tendency to fatten, while its proboscis, which enables it to feed on small trees and under-brush, assimilates it to the elephant. The tapir has been domesticated in Brazil, and used for burdens, being able to carry more than a mule, and being found to be a very docile and manageable animal. Statements as to the character of its flesh differ.

There are found in South America several small quadrupeds, inhabitants of woods, marshes, and pampas, which, it is thought, might be introduced with similar places elsewhere, especial value being set upon those which are allied to the hare and rabbit.

Among the many species of antelope which inhabit southern Africa, are some of great size and of excellent flesh, such as the eland, or *Boselaphus orcas*, which has been introduced into England, and which it has been proposed to keep and fatten in parks and forests.

We find in Knight's English Encyclopedia the following remarks concerning this animal: "The eland is a large, heavy animal, which, when full grown, weighs from seven to nine hundredweight, and, contrary to the usual rule observed among antelopes, is commonly extremely fat. Its flesh is consequently more praised than that of any other wild animal of south Africa, and the large muscles of the thighs, in particular, are held in the highest estimation, when dried and cured, under which form they are denominated thigh tongues. The character of this animal is very mild, and, as it were, predisposed to domestication; it is gregarious, and lives in large herds upon the open plains and low hills, the old males generally residing apart.

"They are so gentle that a man on horse-back may penetrate into the middle of the herd without alarming them, and pick out the fattest and best conditioned; and, as the old bulls are commonly chosen, on account of their greater size and weight, it not unfrequently happens that the herd is left altogether without a male."

Mr. Livingstone says: "Our party was well supplied with eland flesh, during our passage through the desert; and, it being superior to beef, and the animal as large as an ox, it seems strange it has not yet been introduced into England." After having penetrated some distance into the interior of southern Africa, Mr. Livingston found a new variety of the eland, with whose beauty and fine proportions he was much impressed. The engraving of it, published in the account

of his travels, represents it as having, in a very marked degree, that rectangular outline of body which, it has been remarked, is the configuration most to be desired in animals destined for food, since it gives the greatest amount of flesh within the smallest surface.

Sir Cornwallis Harris remarks of the eland: "In shape and general appearance, he resembles a gazerat ox, not unfrequently attaining the height of nineteen hands at the withers, and absolutely weighing from fifteen hundred to two thousand pounds. By all classes in Africa, the flesh of the eland is deservedly esteemed over that of any other animal.

"Both in grain and flavor it resembles beef, but is far better tasted and more delicate, possessing a pure game flavor, and exhibiting the most tempting looking layers of fat and lean, the surprising quantity of the former ingredient, with which it is interlarded, exceeding that of any other game quadruped with which I am acquainted. The venison fairly melts in the mouth; and, as for the brisket, that is absolutely a cut for a monarch. During the greater part of our journey, it was to the flesh of this goodly beast that we principally looked for our daily rations, both on account of its vast superiority over all other wild flesh, and from the circumstance of its being obtainable in larger quantitities with comparatively less labor."

Passing over many valuable quadrupeds, from various parts of the world, we find, among birds, and especially among those of southern and tropical countries, quite a number which promise to be of value, if acclimated and domesticated. Such are the hocco, a handsome bird, more resembling the turkey than any other domestic fowl; the Egyptian goose, already a domestic bird, and prized for the beauty of its plumage, as well as for its more substantial qualities; and a variety of other species.

The most remarkable, however, of all the feathered tribe, seems to be the golden-breasted agami, of South America, a bird whose sagacity and domestic habits are represented as being more like those of the most intelligent quadrupeds, than those belonging to any other animal of its own class. It is said to take the same care of a flock of other birds that a shepherd's dog does of sheep, and to evince, like the dog, great attachment to its master and watchfulness of his premises. Concerning this bird, St. Hilaire writes: "The useful services which the agami is capable of rendering, have been long since pointed out. It is a bird, say Daubenton and Bernardin de St. Pierre, that has the instinct and the fidelity of the dog; it will lead a flock of poultry, or even a flock of sheep, by whom it will make itself obeyed, although it is not larger than a chicken. It is not less useful in the poultry-yard than in the field; it maintains order there, protects the weak against the strong, stands by young chickens and ducks, and divides among them their food, from which it keeps away others, and will not even touch itself. No animal, perhaps, is more easily taught, or naturally more attached to man. But we have not been able to obtain, in this cold climate, (Paris,) the reproduction of this valuable species. Experiments made in the *south* of France would doubtless succeed better." The observations on the habits of the agami, the results of

which are above given, have been made, not only in its native country, but also in the menagery at Paris.

Birds are of service to man, not only by reason of the flesh, the eggs, and the feathers which they produce, but also by destroying noxious reptiles and insects. There are certain birds in Africa which feed upon serpents, and it is proposed to acclimate one species of such, the secretary bird, in the French colony of Martinique, which is infested by poisonous snakes, more especially by the lance-headed viper.

The destruction of insects by birds is a matter of great importance to the agriculturist, and where insect-eating birds are few, insects injurious to vegetation multiply to an enormous extent. A large number of sparrows are said to have been carried from England to one of her Australian colonies, with the view of acclimating there a race that would protect the crops from ravage.

The transplantation of fishes from one place to another was advocated by Daubenton, and by others, especially by Lacépède, the author of "The Natural History of Fishes;" and when we consider the excellence of the flesh of certain fishes, and the great numbers of them which lakes and rivers may, by proper management, be made to support, no class of animals would seem more deserving of such care. The attention paid in France to these subjects has, within a few years, led to the establishment of what is now very well known as the art of fish cultivation, or pisciculture, it having been found that, with a little care and expense, fish can be raised from the spawn in almost indefinite numbers. Lakes and rivers have, by means of this art, been restocked with species that had been almost entirely destroyed in them, and enriched by the introduction of new ones. Those fish which, like the salmon, inhabit the sea, but enter rivers at certain periods, will, if taken care of until of a sufficient size, and then turned loose into the river, seek the sea, and return to the same river the next year, having acquired in the meantime a very greatly increased bulk.

Thus, the fish cultivator turns his swarm out to fatten in the ocean, as well assured of their return in due time as a shepherd is of the coming back of his flock to their nightly fold.

More lately still, it has been discovered that the ova of *oysters* may be collected in large numbers on branches of trees, &c., which are placed in the water above the oyster beds, and that the embryos, which have thus been saved from being floated away and lost, may be transplanted to new beds, where they will rapidly increase in size and multiply in numbers.

The Society of Acclimation has given incidental attention to the introduction of new vegetables, and what it has done with regard to the Chinese sugar-cane, and other plants, has produced great practical results more rapidly than could be expected in the care of animals, the growth and multiplication of which is so much slower; but its labors in the vegetable kingdom are irrelative to our present subject.

The naturalization of foreign animals, which is a very useful and praiseworthy enterprise in France, would be one still more so in a country which offers so vast a field for the support of animal life as does our own, and which possesses a range of climate and a variety of soil so great that almost any animal might find somewhere in it an

appropriate habitation. It is no valid objection to the introduction of a new animal species to say that those already possessed are equally or more valuable, for one animal does not necessarily displace another, nor are we called upon to make a choice between them; if wild, the one often lives on nourishment which would not be made use of by the other, and inhabits places which the other would not frequent; if tame, each is found to be the better adapted for certain uses, or for living in certain places. There is no species of our domestic animals which we would be willing to part with for the sake of bestowing more undivided attention on those that would be left; and as we have at present no animal, however humble, which does not possess a value, may we not expect that those hereafter to be introduced or domesticated will also find their appropriate uses. Nor is the idea, entertained by some, that each animal is fitted only for the soil and the climate to which it is indigenous, and cannot retain its health and vigor after being carried to a strange land, borne out by an examination of facts. The camel is originally, as far as can be ascertained, the native of a cold and mountainous country, and recent travelers have found it carrying burdens over the frozen plains and through the tremendous mountain passes of Thibet; but the same species, acclimated from time immemorial in Arabia and Africa, endures the fiercest rays of a tropical sun.

Horses are to be found in all climates, from Siberia to the Sahara, and if any difference in the quality of horses of different climates exists, it is rather in favor of that which is most unlike their original one. Whatever other animals man has thought fit to carry with him from one place to another exhibit a similar power of acclimation. Not that races can be *suddenly* removed from one extreme of climate to another, without risk of perishing, or that the individual animals who are subjected to a removal involving a considerable change always do well; on the contrary, of all transported, perhaps only a few, whose constitutions are well adapted for the new condition of things, survive; but these become the progenitors of an *acclimated,* or *naturalized* race, who perpetuate among themselves a fitness for that particular climate; so that, if out of a great number tried, only two are found who survive the transportation and to reproduce their species, their offspring may do well and multiply rapidly in the new location.

In this manner human agency may acclimate animals in countries to which they probably would not have gone in their wild state, even if the way had been open to them, the acclimated race being a true variety of the animal produced by breeding from certain peculiar individuals.

The results which have thus far attended the acclimation of the animals of the old continent on the new, give great encouragement to future attempts. Not only have such animals multiplied rapidly in the domestic condition, but also, in some cases, in the wild state. Thus, on the vast pampas of South America, the horse and the ox exist wild, in greater numbers than on any other part of the earth, yet they are all sprung from the few animals which escaped from the Spaniards after their landing in the country.

Most of the domestic animals of the old continent have been accli-

mated in North America without the least difficulty, and the camel, which is the last importation of that kind, bids fair to do as well as those which have gone before it.

The enterprise of naturalizing foreign animals requires to be carried on with great judgment, both as to the species to be selected and to the places where they are to be first located. It is a remark made by an experienced naturalist, that not only are the animal species, from which selections may be made, more numerous in the southern than in the northern parts of the world, but that the acclimation of an animal from a warm region into a cold one is more easily accomplished than that of an animal from a colder into a warmer. Animals from a warmer climate should, therefore, other things being equal, be chosen in preference; and, in any country, the chief establishment for acclimation should be near its most southern border, a point from whence animals may, as they become inured to the climate, spread northward. An animal from a cold climate should, however, be carried to a warmer with great caution; for example, the fleece-bearing animals, from cold mountains and table lands, such as the llama, the alpaca, and the yak, should be naturalized in the coldest and most mountainous districts that are readily accessible.

A further very important care is requisite. Animals chosen for acclimation are often exposed to great dangers at first, from the change in climate and habits to which they are subjected, and this is more especially the case with those which have not been previously domesticated. Their death, under such circumstances, not only involves the loss of the trouble, and expense which may have been incurred in procuring them, but has a bad moral effect by discouraging a useful enterprise, and creating a false impression as to its feasibility. Such difficulties can be best met by putting the animals under the care of men who are acquainted, not only with their habits, but also with the proper means of preserving and of restoring their health. Under the charge of skillful veterinarians, establishments for the acclimation of animals might obtain them from foreign countries, watch over and support them during the first years of their transplanted life, and distribute their offspring to those places where they would be useful in domestic service, or where they would people those regions of country which are unremunerative to the labors of the husbandman, or, as yet, unsettled by him.

The naturalization of foreign domestic animals is at the present day by no means an entirely neglected subject in this country; for, not to speak of other instances of progress, it is well known that Dr. Davis, of South Carolina, has introduced into his native State more than one valuable animal, and, in fact, may be said to have commenced there a system of acclimation.

The domestication of wild animals is an enterprise which is closely connected with that of acclimation, and opens a still wider field for human progress. While the natural instincts of some animals are such as to render it practically impossible to tame them as a race, with many others it is very different; and while some of those which it is practicable to domesticate would, perhaps, not repay the trouble of doing so, there must remain many which would be exceedingly valuable.

On this point, St. Hilaire remarks: "Of the one hundred and forty thousand animal species at present known, how many does man possess in the domesticated condition? Forty-three; and, furthermore, of these forty-three species, ten are wanting in France, and eight in all Europe. Can this be held to be a sufficient conquest of Nature?"

Long ago, Buffon wrote in these terms: "We should feel from this example how great is the generosity of Nature toward us; we use but little of the treasures which she offers, the store of which is greater than we can imagine. She has given us the horse, the ox, the sheep, and all our other domestic animals, to labor for, to feed, and to clothe us; and she has yet in reserve, species which can supply to us whatever is yet wanting, and which only wait for us to subdue them, and to make them serve our wants. Men understand too little of what Nature can do, and of what they themselves could do with Nature. Instead of seeking out that which they do not yet know of, they prefer to misuse whatever is already known to them."

The voice of great philosophers has thus been raised, in former as well as in recent times, to call mankind to this path of progress, and it would become no country more than our own to respond to the call, and to none has Providence given greater means of doing so with effect, or a greater prospect of advantage from such conquests over Nature.

FISH BREEDING.

BY J. C. COMSTOCK, OF HARTFORD, CONNECTICUT.

Fluellen. * * * There is a river in Macedon, and there is also, moreover, a river at Monmouth; * * * and there is *salmons* in both.—King Henry V, *Act* IV, *Scene* VII.

However "goot a man in the disciplines of the wars, and in other particularities," the brave but pragmatical Fluellen may have been, his parallel between "Alexander the pig" and "Harry of Monmouth," certainly did not hold good in the "particularity" above quoted, since no river in Macedon ever did contain "salmons." The comparison would be still more liable to objection if made at the present day; for, however abundant "salmons" may have been in the Wye in the time of Henry V, their number in that river has now become so much diminished that there is serious prospect of its being at last reduced to the salmonless condition of its Macedonian compeer, and that the actual truth of a parallel between them will be found in the assertion that there is salmons in neither.—(See London Quarterly Review, January, 1857.)

This assertion is, unhappily, already literally true in reference to most of those rivers in the eastern United States which once were frequented by salmon, and is applicable alike to the Susquehanna, the Delaware, the Passaic, the Hudson, the Connecticut, the Merrimac, and their tributaries. The same process of extinction is gradually going on in the rivers to the northward of them; and even in the British Provinces, where, until recently, salmon have been quite

abundant, their great diminution in numbers within a few years past has excited inquiry as to its causes, and led to the enactment of laws for its prevention.

It is not probable, however, that the most judicious legal regulations, even if strictly enforced, will ever have the effect of restoring the population of our waters to its pristine abundance. There would appear to be causes for its diminution which lie beyond legislation, and which are inherent in the changes produced by the extension of human improvements over the surface of the earth. We find, in fact, that many species of animals, once numerous and important as objects of the chase, or as furnishing food to the earlier settlers of what are now densely-populated regions, have, in like manner, receded from the presence of advancing civilization, and are either quite extinct or rarely met with in the places which they formerly inhabited.

Thus, it is probable that the bison once extended its range as far to the eastward as the Hudson river, and perhaps even into New England. The wapiti, or American elk, (*cervus canadensis,*) once an inhabitant of the northeastern States, and said to have been killed on Long Island within the past forty years, is now found east of the Missouri only in one or two isolated localities, if at all. The cougar, the moose, the bear, the wolf, the beaver, the wild turkey, the Virginia deer, the pinnated grouse, have all been compelled to follow the same law, have totally disappeared from many sections of country where they were once common, and are gradually, but surely, losing their residence even in those more remote regions to which they have retreated.

The effects of the changes produced by an increase of human population are not, perhaps, so soon perceptible in their operation upon the inhabitants of the waters; and it is only at a comparatively recent date that the diminished supply of most species of fresh-water fishes has begun to be seriously felt. But it is a fact, within the notice and experience of every observing person, that streams and lakes in densely-populated districts do not now afford the supply of fish which they did formerly, and that this is the case even in large rivers which had, from time immemorial, been resorted to by migratory fishes, for the purpose of spawning. On all such rivers in this country the fisheries are yearly declining in value and importance, and upon many of them the occupation of the fisherman is well-nigh gone.

The building of dams across the tributary streams, by means of which the fish are prevented from ascending to their proper spawning grounds; the erection of mills and factories, and the consequent pollution of the waters by saw-dust and the refuse of chemical ingredients used in the different processes of manufacturing; and the disturbance of the larger rivers by the passage of steamboats, may be properly reckoned among the proximate causes which induce the fish to desert their accustomed haunts. Add to this the reckless conduct of a class of persons who should be most solicitous for the preservation of the fish—that is, the fishermen themselves—who everywhere disregard all considerations of propriety and humanity in reference to time and mode of fishing, and it really seems a most remarkable test of the immense

natural fecundity of fishes, that a sufficient number remain in these localities to perpetuate their species at all.

Legislative restrictions seem entirely to have failed in checking the improvidence and rapacity of these men; and the difficulty of enforcing even the most judicious fishing laws would appear to be insuperable. Of such laws, indeed, as well as of those which respect the preservation of game, our people are exceedingly impatient, regarding them much in the light of sumptuary regulations, and sturdily resenting any interference with what has long been considered the free right of every man to take fish and fowl in any way, and at any time he pleases. It is not too much, then, to say that, in every part of the country, existing fishing acts, which are intended to regulate the time and method of taking fish, are almost totally disregarded, and with perfect impunity.

But there are also other reasons for the decline of our river fisheries, in addition to those already enumerated. These lie in the gradual but perceptible changes which are taking place in the character of the rivers themselves; and the influence which they exert upon the result in question is so important, and yet so little understood; that it should not be passed in silence here. The changes alluded to are well and clearly enumerated by one of our most accomplished American scholars, Hon. George P. Marsh,* in the following language: "Although we cannot confidently affirm that the total quantity of water flowing over the beds of our streams in a year is greater or less than it was a century ago, or that the annual mean temperature has been raised or lowered, yet it is certain that, while the spring and autumnal freshets are more violent, the volume of water, in the dry season, is less in all our water-courses than it formerly was, and there is no doubt that the summer temperature of the brooks has been elevated. The clearing of the woods has been attended with the removal of many obstructions to the flow of water over the general surface, as well as in the beds of the streams, and the consequently more rapid drainage of our territory has not been checked in a corresponding degree by the numerous dams which have been erected in every suitable locality. The waters which fall from the clouds, in the shape of rain and snow, find their way more quickly to the channels of the brooks, and the brooks themselves run with a swifter current in high water. Many brooks and rivulets, which once flowed with a clear, gentle, and equable stream through the year, are now dry, or nearly so, in the summer, but turbid with mud and swollen to the size of a river after heavy rains or sudden thaws. The general character of our water-courses has become, in fact, more *torrential*, and this revolution has been accompanied with great changes in the configuration of their beds, as well as in the fluctuating rapidity of their streams. In inundations, not only does the mechanical violence of the current destroy or sweep down fish and their eggs, and fill the water with mud and other impurities, but it continually changes the beds and banks of the streams, and thus renders it difficult and often impossible for fish to fulfill that law of their nature which impels them annually to return to their breeding place to deposit their spawn.

*Report on the Artificial Propagation of Fish, to Legislature of Vermont, 1857.

The gravelly reach, which this year forms an appropriate place of deposit for eggs, and for the nutriment and growth of the fry, may be converted the next season into dry land, or, on the other hand, into a deep and slimy eddy. The fish are therefore constantly disturbed and annoyed in the function of reproduction, precisely the function of all others which is most likely to be impeded and thwarted by great changes in the external conditions under which it is performed. Besides this, the changes in the surface of our soil and the character of our waters involve great changes, also, in the nutriment which Nature supplies to the fish; and while the food appropriate for one species may be greatly increased, that suited to another may be as much diminished. Forests, and streams flowing through them, are inhabited by different insects, or at least by a greater or less abundance of the same insects, than open grounds and unshaded waters. The young of fish feed, in an important measure, on the larvæ of species which, like the musquito, pass one stage of their existence in the water, another on the land, or in the air. The numbers of many such insects have diminished with the extent of the forests; while other tribes, which, like the grasshopper, and suited to the nourishment of full-grown fish, have multiplied in proportion to the increase of cleared and cultivated ground. Without citing further examples, which might be indefinitely multiplied, it is enough to say that human *improvements* have produced an almost total change in all the external conditions of piscatorial life, whether as respects reproduction, nutriment, or causes of destruction, and we must of course expect that the number of our fish will be greatly affected by these revolutions.

"The unfavorable influences which have been alluded to," proceeds Mr. Marsh, "are, for the most part, of a kind which cannot be removed or controlled. We cannot destroy our dams, or provide artificial water-ways for the migration of fish, which shall fully supply the place of the natural channels; we cannot wholly prevent the discharge of deleterious substances from our industrial establishments into our running waters; we cannot check the violence of our freshets, or restore the flow of our brooks in the dry season; and we cannot repeal or modify the laws by which Nature regulates the quantity of food which she spontaneously supplies to her humbler creatures."

Taking all these circumstances into consideration, we are forced to the conclusion that our public fresh-water fisheries can never be restored to their pristine value and importance, but that they must everywhere gradually but surely decline. In this state of things, it becomes a matter of great interest to determine whether the supply of an article of food so wholesome, so abundant, and so cheap, as that hitherto afforded by these fisheries, can, in any manner or to any considerable extent, be still maintained by the application of enterprise and ingenuity to waters under private control, and whether the multiplication of valuable species of fish in such waters may not become an important accessory to agriculture. It is true that we believe the art of pisciculture likely to be of service; and it is in this aspect that we propose to consider the subject at present.

The breeding, preserving, and fattening of fish, as a branch of domestic economy, has been practiced in various methods, among various

nations, from time immemorial. The Chinese are said to have carried on for ages a traffic in the eggs deposited by salmon, trout, sturgeon, and other species, at the spawning season, in places prepared for the purpose, in rivers frequented by these fish; the eggs thus collected being sold and transported to different parts of the country, to be used in stocking private waters. Among the Romans the same method was practised, at a very early period, for peopling lakes and ponds with fish. At a later era, the taste of the wealthy patricians for fish-raising appears to have become a passion, and the enormous sums said to have been lavished by them upon the construction of their ponds and the feeding and preservation of choice varieties of fish, seem almost incredible.

During the middle ages, the kings and princes of Europe, as well as all the great ecclesiastical communities, maintained their artificial preserves, some of which were of great extent and supplied large quantities of fish. A fish-pond was an indispensable appendage to nearly every monastic establishment, and the priestly epicures were always well skilled in its management. They took care to stock their preserves with the most valuable species, which they often transported from distant places for this purpose. There are good reasons for supposing that the carp, the grayling, the charr, and perhaps other species, were in this way introduced into English waters, when England was Catholic. It would seem, indeed, that, in all probability, Dom Pinchon, a monk of the abbey of Réome, in France, was the inventor of the process of artificially fecundating the eggs of fish. This method of performing this operation is described in a manuscript recently brought to light, dated in 1420, and differs little from that practiced at the present day. The experiments of Dom Pinchon were, however, never published, and the credit of the modern invention of breeding fish artificially unquestionably belongs to Mr. Jacobi, a German gentleman who, in the year 1763, communicated to the Hanover Magazine an interesting account of his plan for the breeding of trout by artificial impregnation of their ova. His invention, as he states, was the result of many experiments, made during a series of not less than forty years; and it certainly contains the substance of nearly all that later practitioners consider essential to success. Though the process of Jacobi attracted some attention among the scientific men of his day, and was the means of stocking some waters in Holland, yet it appears to have fallen into disuse, and to have slumbered for a long time among those forgotten inventions which are so often claimed as new discoveries by a succeeding age.

About fifty years later than the time of Jacobi, that is, from 1830 to 1835, a series of really accurate and scientific observations were made in Scotland, in reference to the habits of fish at the spawning season—habits upon which the whole art of artificial propagation is founded. These observations would appear to have been originally instituted by Dr. Knox, of Edinburg, who watched the process of spawning, in the case of the salmon, and observed the progressive development of the ova, and the growth of the young fishes after exclusion. His hints were followed up, at about the same period, by a most acute and patient observer, Mr. John Shaw, who devoted himself for several

years to a series of well-managed observations on the natural history of the salmon, and the facts, clearly stated and thoroughly proved, which he details in regard to the time and mode of spawning, progressive growth, migration to and from the sea, and other habits of that valuable fish, will always possess the greatest interest. Similar observations were also made by Mr. Andrew Young and others, in the Scottish rivers.

It is, however, within the past ten or twelve years, that pisciculture has, so to speak, taken its place among the useful arts, and been extensively applied to economic purposes. The attention of the French government was called, in 1848, to the experiments of two fishermen of the department of the Vosges, MM. Gehin and Remy, who had occupied themselves for several years in breeding trout, perch, and other species, with which they had succeeded in stocking many of the ponds and streams of their neighborhood. The subject was eagerly taken up by some of the most distinguished scientific men of France. Inquiries were instituted, reports made, an appropriation granted by the government, and an institution established for the purpose of hatching, rearing, and transporting fish, which went into operation in 1852, under the direction of M. Coste, a savant of distinction. Since then, experiments have been made, with varied success, in different parts of Europe, and to some extent in this country. It is not yet time to pronounce positively upon the value of these experiments as applicable to the stocking of public waters. In this country especially, little has, as yet, been actually accomplished in this direction, and we are unable to present definite and reliable results. But there is great encouragement to hope that the processes of pisciculture may yet become of great public benefit.

Whatever may be the result of attempts to revive the fisheries, the stocking of ponds and streams under private control is not only practicable, but requires little more than ordinary skill and care, and there can be no doubt that, as a matter of both profit and pleasure, it is worthy the attention of agriculturists.

Having alluded to the main facts in the history of pisciculture, the natural method of reproduction in fishes may be described, since it is by imitating this method as nearly as possible that artificial propagation is most likely to succeed.

Fresh-water fishes, in reference to their time and mode of spawning, may be divided into two classes:

1. Those which deposit their eggs in the autumn and winter, in water of a reduced temperature, and require a long period of incubation.

2. Those which spawn in the spring and early summer, and the eggs of which hatch in a few days or weeks.

The first of these classes contains some of the most beautiful and valuable of the inhabitants of the waters—those which belong to the family of the salmon and trout, including also the several species of shad-salmon, or white fish. Some of them migrate from the sea into the rivers for the purpose of spawning, as the sea salmon; others, as the brook trout, perform partial migrations up the smaller streams, for the same purpose; while the lake trout and the white fish deposit

their eggs on the sandy shallows, near the shores of the more extensive waters which they inhabit. The operation of spawning, in the case of the salmon, may be briefly described as follows:

The male and female, having paired, seek a suitable spot for the location of their spawning-bed, in a shallow part of the stream, where the water runs over a gravelly and sandy bottom. An excavation is then formed, of considerable width, by the action of the snouts and tails of the fishes, burrowing into the gravel, against the current. The nest having been made sufficiently capacious, the female deposits in it a portion of her ova, and, dropping down the stream, her place is instantly supplied by the male, who emits a quantity of milt upon the eggs. The eggs, being thus impregnated, are partially covered by the loose sand and gravel brought down by the current, and a second bed is soon made, a little higher up the stream, in which another portion of the ova is deposited, to be fecundated in like manner. This process is continued from day to day, until the female has no more ova to deposit. The process being finished, the salmon drop down into some deeper pool, where they remain for a while, in order partially to recover from the exhausting effects of their labors, and then return slowly down the river to the sea. The eggs remain until spring before hatching, the time required for incubation being from ninety to one hundred and twenty days. When first excluded from the egg, the little fish measures about half an inch in length, and presents a singular appearance. The dorsal, caudal, and anal fins are continuous, like those of the eel, and form a kind of fringe, running from the head to the tail. The yolk of the egg remains attached to the belly of the fish, and communicates with the intestinal canal by a passage through which the yolk is gradually drawn inward and digested. During this time the young fish needs no other nourishment, but at the end of about a month the yolk-sac becomes exhausted, and the appetite for food begins. The growth of these fishes (the salmon and trout) is slow during the first year, but more rapid during the second and third.

The development of the ova in those fishes which belong to the second class, viz: those which spawn in the spring and summer, is much more rapid, and in some of them the process of spawning is somewhat different. Thus, the perch deposits its ova in the form of continuous clusters, attached to stones or water plants by a glutinous film, and the young are hatched in the course of two or three weeks. All the cyprionoid fishes (those belonging to the family of the carp, dace, &c.,) also spawn in the spring, and their time of incubation is equally short, The same may be said of the shad, of the different species of herring, of the pikes, pickerel, &c., and indeed of all fishes which spawn during the warmer months.

The following is a list of some of the most valuable of the fishes of the United States which spawn in fresh water, classified with reference to their times of spawning:

AUTUMN AND WINTER.

Sea salmon, (*Salmo salar.*)
Brook trout, (*Salmo fontinalis.*)
Lake trout, (*Salmo confinis,* &c.)
Lake white fish, (*Ceregonus albus,* &c.)

SPRING AND SUMMER.

Pickerel, (*Esox reticulatus.*)
Mascalonge, (*Esox estor.*)
Perch, (*Perca flavescens.*)
Pike-perch, &c., (*Lucioperca Americana.*)
Striped bass, (*Labrax lineatus.*)
Black bass, (*Grystes nigricans,* &c.)
Rock bass, &c., (*Centrarchus æneus.*)
Shad, (*Alosa præstabilis.*)

The number of eggs deposited by a single salmon in one season has been estimated at from ten thousand to twenty-five thousand; by the perch, two hundred thousand; the pike, one hundred thousand. Of these, it is supposed that at least three quarters fail to become productive, being devoured by other fishes, washed down and buried in the mud by freshets, and exposed to many other casualties. Countless millions of the young also are destroyed before they become capable of propagating their species, and still greater numbers of the ova are never deposited at all, being destroyed while yet immotive, in the body of the parent fish, which, in most cases, is most readily captured at the season when it seeks its spawning grounds. The object of artificial breeding, then, is to secure the spawn of valuable fishes against the operation of these untoward contingencies, to place it in those conditions where a larger comparative proportion may become productive, and to preserve the young fishes from the dangers which surround them in their natural element.

The processes of artificial breeding are simple and easy, but, at some stages, they require care and experience. The mode of impregnating the eggs is readily learned, with a little practice. The female fish is taken at a time when the spawn is mature, and is held over a shallow vessel containing a quart or so of pure water. A very slight pressure along the abdomen will cause the eggs, if sufficiently mature, to fall into the water. If they do not come away readily, the indication is that they are not yet mature, and the fish should be preserved for a few days, when the trial may be repeated. The object is to procure the eggs in the exact state when they will most readily receive the fecundating influence of the milt of the male fish. This must be judged of by experience. After the female fish has been thus treated, the milt is obtained from the male in the same manner. If mature, the milt will flow readily from the fish, and will give the water a whitish and turbid appearance. The water should be slightly agitated—as well by the tail of the male fish as in any other way—while

the emission of the milt is taking place, so as to insure the thorough contact of the two elements. A little practice will enable the operator to perform this manipulation without injury to the fishes, which, after their supply of eggs and milt is exhausted, may be replaced in the pond or stream from which they were taken, and thus reserved for breeding a second year. The milt from a single male will be found sufficient to impregnate the ova of numerous females, but the mixture of it with the eggs must be effected as soon as possible after their extension.

The eggs, after being thus impregnated, are placed in hatching boxes prepared to receive them. These may be constructed in several different methods. Those used by Jacobi were wooden troughs, with a wire grating at either end, to keep out destructive fishes and insects, the bottom being covered with a layer of gravel. The eggs were strewed on the gravel, care being taken to place them so as not to lie in heaps, and the water of a running stream was conducted through the gratings. The apparatus of Gehin and Rémy consisted of a tin box, the cover and sides being pierced with holes to admit the water, and the bottom in like manner covered with gravel. The box and its contents were placed in the bed of a stream. The French savans have invented several improvements in the hatching apparatus, one of the best of which is said to be the use of willow or fine wire gratings, on which the eggs are placed, and which are suspended in the water by means of sliding rods, thus dispensing entirely with the gravel bottom, and retaining the eggs in a position where they can be more readily examined, and are not so liable to be injured by being piled together by the flow of water.

During incubation the eggs should be inspected daily, and those which prove to be unimpregnated removed. These are readily distinguished from the others by their greater opacity, and, if allowed to remain in contact with the rest, would soon spoil them. There is also a minute species of parasitic mildew, which is very injurious to the eggs, and difficult to exclude, as its spores are deposited with the sediment of the water. In order to prevent its ravages as far as possible, the eggs should be daily cleansed, and the sediment prevented from settling on them by means of a soft hair pencil. Where it is practicable to do so, it is recommended to filter the water, in order to obviate this difficulty.

It is not possible, within the limits of this paper, to give particular directions as to the construction of hatching apparatus. The ingenuity of almost any country gentleman or farmer will point out to him some contrivance which will fulfill the conditions necessary for the purpose. A constant stream of pure water bathing the eggs is all that is necessary, in addition to the other precautions mentioned.

The progressive development of the embryo, as watched from day to day under the microscope, becomes very interesting, and is fully described in the works which will be hereafter mentioned.

After the young fishes are hatched, they should be removed to a larger receptacle; they need little care, however, until the yolk-sac is exhausted, and they begin to require food. This may be supplied in the form of finely-comminuted flesh or fish, the fibres of which have

been separated by boiling. Care should be taken not to place so much of this in the box in which the young fish are kept as to corrupt the water.

Well cared for, young trout will attain the length of about three inches the first year. They should then be turned into a pond, and allowed to provide for themselves. It would be well, however, to have for this purpose two or three separate ponds, to contain the broods of each successive year. This precaution is required in consequence of the predatory nature of these fishes, and the liability of the younger to be devoured by the older. Some other species of fish, of a smaller and inferior kind, may, with advantage, be placed and permitted to breed in the pond, for the purpose of supplying food to the trout.

In a region where trout are abundant, of course much of the trouble of artificial breeding may be dispensed with, provided a pond can be constructed by damming the course of a stream already populated by them. They may then be left to their natural instinct, and, if the stream affords suitable spawning places, they will maintain the supply of young needed each year, with no further care. But it is absolutely necessary, for the reproduction of trout, that their eggs should be deposited, during incubation, in running water, highly aerated; and hence it is that they will never increase in number while confined to the still waters of a pond. They will neither grow well nor become of good flavor in water rendered turbid by vegetable matter, nor where the bottom is muddy. Clear, cool, spring water, resting on a sandy and gravelly bottom, is indispensable to the full development of their good qualities. In constructing a pond for the reception of this most valuable and beautiful of all fishes, these conditions should be recollected.

After the ova of fishes have been fecundated, they may be transported to considerable distances, provided they be kept moist and cool. The simplest method is to pack them in alternate layers (taking care that the eggs do not touch each other) with fine sand, shaggy woolen clothes, or aquatic plants, in small boxes. The boxes for this purpose may be six or eight inches square by three or four deep, and care should be taken that the contents be thoroughly moistened before they are closed. The eggs of the lake trout, the lake white-fish, and the pike-perch have thus been brought from Ohio and Lake Ontario to Connecticut, in perfect condition. Indeed, eggs of the salmon and trout thus packed will retain their capacity of development for several weeks. The eggs of those fishes which spawn in summer, however, would not probably bear transportation so easily, but would be much more likely to prove unproductive, after being carried long distances. Care must be taken to admit water gradually to the eggs thus procured, especially if they have been for several days on their journey they are liable to be spoiled by too rapid absorption of fluid.

The introduction of fishes peculiar to one country, or to one section of a country, into distant waters, is by this means readily effected, suitable breeding places being provided in advance for the reception of the ova.

The most extensive and important operation of this kind yet undertaken in this country has been attempted for the purpose of introducing

some of the fishes of the great lakes into waters which they did not previously inhabit. A brief account of the measures taken for this purpose, and which are believed to have resulted in at least partial success, will not be out of place here.

Saltonstall lake is a very beautiful body of water, almost three miles in length, situated a few miles from the city of New Haven, Connecticut. It was selected as the locality of the intended experiments, because, in position, size, quality of water and of shores, and in all other respects, it was believed to combine the conditions most favorable to success. Like most of the New England lakes of its class, it was already populated with pickerel, perch, eels, and other common species. In the spring of 1857, an act was passed by the legislature of Connecticut affording ample protection to the enterprise, and the gentlemen concerned also procured from the riparian proprietors grants of their fishing rights in the lake, so that they thus acquired complete control of its waters. A small, but constantly flowing stream, one of the feeders of the lake, was prepared for the reception of the ova, by forming it into a series of shallow pools, and strewing the bed with a layer of clean gravel and small stones. The intention, in this case, was to procure so large a quantity of ova as to be able to allow them to run the hazard of being hatched in the open stream.

The lake trout (*Salmo confinis*) and the white-fish (*Ceregonus albus*) were the species chosen as those most likely to become readily acclimated, and as otherwise most valuable to the breeder. In November of the same year the first supply of the eggs of these species was procured at a fishing station on Lake Ontario; the trout and white-fish being taken alive from the fishermen's nets, and the ova artificially fecundated on the spot, in the manner heretofore described. They were then packed in alternate layers with fine wet sand, in wooden boxes, and the proper precautions taken to insure safe transportation. On the 17th of November, 1857, the previous cargo, estimated at about five millions of the eggs of the trout, and one million of those of the white-fish, arrived at the place for which they were destined, apparently in good condition. They were unpacked with great care, and those of the trout were partly deposited in the bed of the stream, and partly along the gravelly shores near its embouchure, in water of two or three feet deep. Those of the white-fish were placed upon a smooth, sandy shoal, in water of somewhat less depth, the intention, in both cases, being to place the eggs in positions, as nearly as possible, similar to those in which the fish themselves deposit them. During the winter the eggs in the stream were repeatedly examined, and many of them found to be progressing favorably toward their development; and in March and April, 1858, the young made their appearance in great numbers. They were allowed to take care of themselves, and in due time they proceeded down into the lake. It was impossible to ascertain the probable proportion of the eggs which were hatched, but if one out of every thousand produced a living fish, the result of the experiment may be considered satisfactory.

In the month of May of the same year, about twenty millions of the eggs of the pike-perch, (*Lucioperca americana,*) which inhabits the same waters with the lake trout and other white-fish, were collected,

and transmitted to the same breeding-place. Two thirds of them were placed in the stream, and the remainder on the gravel of the lake bottom. Some of those in the stream, after having been deposited about two weeks, were found to be developing properly, and an enormous crop of young fishes was expected; but, unfortunately, a sudden freshet shortly afterward tore up the bed of the rivulet, and swept away and destroyed a great proportion of the ova. What number, if any, survived this disaster, is not known, but it is believed that some of those deposited in the lake, and thus so situated as to have escaped the effects of the freshet, must have arrived at their full development.

In the autumn of 1858 another collection of about ten millions of the ova of the lake trout and white-fish was deposited in the same places, and, from observations made in the spring and summer of 1859, considerable numbers are believed to have been hatched. Several young trout of this brood have been taken in the lake, and also a few of larger size, weighing nearly a pound each, supposed to be the produce of the first deposit of eggs. As the white-fish does not take the hook, its actual presence in the lake has not yet been detected. Measures will be taken, however, in the course of the next summer, to ascertain positively the result of the experiment as regards that species. So confident are the gentlemen concerned, in the entire feasibility of their project, that they intend to continue their operations until assured of full success. They will also introduce other species of lake fish.

It is not yet time to speak confidently upon the prospect of future pecuniary profit, as the ultimate result of these operations; but if the trout, white-fish, and pike-perch do become acclimated and grow to the size which they attain in their native waters, the supply furnished by Saltonstall lake cannot fail, in a few years, largely to repay the parties concerned for their labor and expenses. The writer of this article has felt a very deep interest in these experiments from their inception, has been personally conversant with their progress, and has derived much valuable information respecting practical fish breeding from the two principal conductors of the enterprise, Messrs. Carl Muller, of New York, and Henry Brown, of New Haven.

TRANSPORTATION OF LIVING FISHES.

In some cases it may be desirable to transport living fishes from a distance. Whenever this is to be effected, the chances of success will be greatly increased by the observation of a few simple precautions. Small fishes are much more easily transported than those of full size. To save the trouble of changing the water often, its temperature should be reduced by placing in it pieces of ice so fixed as not to injure the fish. A large tin can, holding from twelve to twenty gallons, with a wide mouth, similar to those used by milk-men, is as convenient as anything. The lump of ice may be suspended in a netting from the mouth, the cover of which should be pierced with holes for the admission of air. If such vessels cannot be obtained, barrels, or even tubs, may be used, care being taken to cover them with some kind of cloth of loose texture, to prevent the water from being thrown out by the jolting of the carriage or rail-car in which the journey is performed.

A sufficient supply of ice should be procured to maintain the water at a low temperature. In such manner Dr. Garlick, of Cleveland, tells us that he kept five hundred and twenty trout in a barrel of water for eighteen hours without changing the water; and Mr. Henry Brown recently carried twelve hundred trout from the northern part of Massachusetts to Long Island, with the loss of only two or three. The water was not changed, and the trout were thirty-six hours on the road.

When the waters from which the fish are to be brought are not too distant, this is an easy mode of procuring material for stocking ponds. As an instance of what may be effected by this method, in stocking waters of considerable extent with new species, the following may be mentioned:

In the winters of 1852–53, the black bass of the lakes (*Grystes nigricans*) was introduced into Waramang lake, situated between the towns of Washington and Warren, in Litchfield county, Connecticut. "They have in that lake," writes our informant, F. D. Beeman, Esq., of Litchfield, "multiplied very generously. Their growth is estimated to be about one pound a year, and they have been frequently caught weighing five pounds and upwards. They were originally brought from a small lake in Duchess county, New York. They are a hardy fish, and can be readily transported from one place to another in a tub of water, covered with wet canvas. There were less than an hundred bass originally placed in Waramang lake; there are now probably millions, and they appear to propagate and flourish better than any other fish in the waters of that lake."

The black bass has more recently been introduced into another lake in Litchfield county, and will soon be established as a denizen of many other of our Connecticut lakes. It is a fine fish, in every respect, and is well worthy the attention of those who have large private ponds. The ease with which it may be transported, the rapidity with which it multiplies, the sport which it affords the angler, and its excellence on the table, form a combination of qualities which render it deservedly popular with those who know its merits, and which should lead to its introduction into all such waters as are suited to its habits.

BREEDING OF MIGRATORY FISHES.

In addition to the experiments already alluded to, others of even greater interest, in some respects, are now in progress. Those which are next to be mentioned will eventually, it is hoped, afford much practical information in regard to the question whether the breeding of *migratory* fishes can be so managed as to be made a source of profit to the breeder: in other words, whether these fishes, after being reared in private waters, and allowed to follow their instincts by going to the sea at the proper age, will return when adult, at the spawning season, to the place where they are hatched, in sufficient numbers to enable the breeder to repay himself for his care of them while young, by capturing and selling them when full grown. Somewhat similar experiments have been made in other countries, for the purpose of settling the same question; but, notwithstanding the enthusiastic anticipations

of foreign fish breeders, we have, as yet, no positive and reliable accounts by which to estimate their value. The importance of the subject warrants a thorough trial, and such, we hope, it is to receive by the means now to be described.

Messrs. U. S. Treat & Son, of Eastport, Maine, have obtained the control of three large ponds, about twenty miles from Eastport. The largest of these is about three quarters of a mile long, by half a mile wide, and they all have a common outlet into the St. Croix river. The outlet has been provided with a gate, by means of which it may be closed or opened at pleasure, thus enabling the owners to retain the fish in the ponds, or to allow them to proceed to the sea. The breeding operations were commenced in the spring of 1857, at which time a number of salmon, (*S. salar*,) striped bass, (*Labrax limatus*,) shad, (*Alosa prœstabilis*,) and alewives (*A. tyrannus*) were placed alive in two of the ponds, the salmon in the largest. The shad and alewives, Mr. Treat informs us, spawned about the first of June, and in about three weeks millions of their young were seen. The gate was then closed, and the growth of the young fish watched in the pond for three months, after which, a portion of them were allowed to proceed down the river to the sea. The remainder were detained for two months longer, when they also were dismissed to salt-water. The number of young produced by this first spawning was estimated at more than five millions. They had grown, when on their way to the sea, to the length of three to five inches. The salmon spawned in the November ensuing, and the eggs were hatched in the spring after. Mr. Treat did not, however, succeed in detecting any of the young until the summer of 1859, when they were above a year old. They had then grown, he says, to the length of ten or twelve inches, and were changing from the trout-like appearance which characterizes them in their first year, and were taking on the silvery coat of the parent fish. As the lake is in some places forty feet in depth, not many of these young salmon were captured; but enough were secured to enable Mr. Treat to identify them. The old salmon still appear to be in good condition, and are frequently observed. They have been in the lake two winters and two summers. Whether they continue to breed is not as yet known. The young salmon were also allowed to follow their natural instincts and to proceed to the sea at the proper season. Mr. Treat confidently expects the return of his fish—such of them as survive the dangers of the seas—as soon as they become capable of reproducing their species and feel the impulse of that instinct which induces them to seek the fresh water for the purpose of depositing their spawn. We shall await the result of his experiments with great interest, and hope to be able, in some future report, to announce the fulfillment of his anticipations. Several other important and doubtful questions, as to some of the habits and the growth of the species which are made the subjects of these experiments, will also, perhaps, be solved.

BREEDING TROUT AT HARTFORD.

Mr. E. C. Kellogg, of Hartford, Connecticut, gives the following account of his experiments. He was among the first to attempt the

artificial breeding of trout in this country, and he has conducted his experiments with great intelligence and care. His observations in regard to the progress of development of the embryo fishes, the best and most certain methods of impregnation, the growth of the young fry, and many other points of interest, have been exceedingly patient and minute, and, when published, as they may be in the Report of next year, will materially add to the stock of knowledge already promulgated by foreign writers, and will, we are certain, prove of material benefit to those who desire to practice the art. At present, we have space only for a brief notice of what he has done and what he is now doing.

His first experiment was made in 1855, during the summer of which year he collected a number of trout, to be used as breeders, which he placed in a small pond in the town of Simsbury, Connecticut. A slight dam was made near the source of the spring by which the pond was supplied, forming a smaller pond, and at the lower side of this upper dam a temporary hatching-house was erected, in which was placed a box partly filled with gravel, and through this a small stream of water was conducted. In November, the eggs were fecundated, after the prescribed method. In the course of a few weeks it was apparent that embryo fish were being developed in some of the eggs, and in proper time about seventy-five trout were hatched. The fry were kept in the box for a month or two, and were then allowed to run into the larger pond below. In the succeeding autumn they were found with the old fish, apparently doing well.

The next year's experiments at Simsbury failed entirely, the water-pipe becoming stopped, so that the water froze in the hatching box. Mr. Kellogg, however, was induced, by the convenience of having the Connecticut river water on his premises, to make a trial of artificial breeding in the cellar of his house. He arranged a box with several partitions, filled it partly with gravel, laid it in a slanting position, so that the partings formed a series of steps, and water from the public reservoir was conducted through it. By this means he succeeded in hatching about sixty trout during the first winter, and about four hundred during the winter of 1858. He is at present directing the construction of works for artificial breeding on a more extensive scale, and on a far more convenient plan, at East Hartford. Through the liberality of Colonel Colt, upon whose grounds the work is progressing, no pains nor expense are spared to render the experiment successful. An excellent spring, running out of a gravel bank into a ravine, furnishes a good supply of water. Across the ravine a dam has been thrown, raising a pond of about sixty feet in diameter and six feet in depth. A commodious house has been built, in which are the arrangements for hatching, and a large tank, with divisions, to hold the parent fish at the time of spawning. A supply of breeding fish has recently been provided, and a considerable number of eggs, probably three or four thousand, have been impregnated and placed in the hatching boxes. Every precaution which experience and ingenuity could suggest has been used to secure successful results, and we hope, next year, to be able to make a satisfactory report of these operations.

"That there is some difficulty in breeding trout artificially," writes

Mr. Kellogg, "I think all who have experimented will allow. It is perhaps somewhat difficult to point out the causes of failure, which seem to lie principally in the uncertainty of fecundating the ova, a very large proportion of which often proves barren, in spite of every care and precaution. We must suppose that some one of the conditions necessary to thorough fecundation has been disregarded or not understood. There is no reason to doubt, however, that the careful observations of experimenters, each succeeding year, will overcome the difficulty, and will lead at last to complete success.

"The rapidity with which fish grow with good feeding is truly surprising. In the basin of a fountain in my garden a single trout has lived during this season. For some time no care was taken to feed this fish, it having been left to depend for its existence upon the few insects which chanced to fall into the water, and for several months it increased in size very slightly. After being fed daily with worms for a few weeks, its growth was remarkable. In a single month it has more than doubled in weight.

"During several winters I have kept in a small tank in the cellar a considerable number of trout, and although quite thin after the spawning season, they have become fat and in excellent condition before spring, by means of generous feeding. It is astonishing, also, to notice how easily fish may be domesticated. Wary trout, after only a few days' confinement, will eat readily, watch daily for their accustomed allowance, and even become so gentle as to take food from the hand, like chickens."

PRACTICAL HINTS TO FISH BREEDERS.

The following instructions, upon several points connected with the different stages of artificial fish breeding, are partly the results of our own observation, and partly condensed from an essay by Professor Vogt, of Geneva, Switzerland, translated for Mr. Marsh's report, before alluded to. This essay contains a very great amount of valuable and curious information, in respect to the reproduction of fishes, and the best methods of securing success in artificial fish breeding. It is worthy of perusal entire, by any one to whom it may be accessible.

1. The mere contact of spawn and milt does not suffice to effect fecundation. To insure the production of a living creature from the egg, the active element of the milt, which consists of moving microscopic corpuscles, provided with a thread-like tail, and called seminal animalcules, must penetrate into the interior of the egg, and there unite with its substance. Every egg is, therefore, infallibly lost, unless it has thus absorbed the constituent of the male generative fluid.

2. The perfect eggs of fresh-water fish consist of an external skin, or shell, within which, enveloped in a second thinner membrane, called the *vitelline membrane*, is the yolk. The yolk is always bright and clear, sometimes quite colorless and transparent, like water, (as in the white-fish,) sometimes of an amber or orange color, as in the trout and salmon. The outer coat of the egg and the vitelline membrane lie in close contact, so long as the spawn remains in the body of the fish; but, as soon as the eggs are deposited in the water, a rapid absorption

commences, the water penetrates through the external coating, which swells and becomes distended, thus leaving a space between itself and the vitelline membrane around the yolk, this space being filled with water. The vitelline membrane is impervious to water, so long as the egg is in a healthy state, and its contents remain perfectly clear and limpid. But the penetration of water into the yolk is at once betrayed, by its assuming a milky color; and this is an infallible proof of the unsoundness of the egg.

3. An orifice is observed in the eggs of most fresh-water fish, opening at the surface, through which the seminal animalcule penetrates to the interior of the egg.

4. Since the spawn can be impregnated only by the reception of the animalcule, it becomes of much practical importance to ascertain how long this minute being retains its power of motion and impregnation. At low temperatures, this power may be retained for hours, and even days, *if the milt remains in the organs in which it is secreted.* The eggs of trout have been impregnated by milt taken from the male after it was stiff-frozen. But, when once the milt is placed in water, the power of moisture is very soon lost. It has been found that the animalcule of the mullet perishes in three minutes and ten seconds; that of the carp in three minutes; that of the perch in two minutes and forty seconds; and this in the degree of heat most favorable to vitality. *Very slight variations, above or below this point, destroy the animalcules with great rapidity.* The temperature which seems longest to maintain their vitality is, for winter fish, like the trout, 41° to 48°; for those which spawn in early spring, 50° to 55°; for those of early summer, 63° to 68°; and for those of hot weather, 77° to 87°.

5. It becomes, therefore, a matter of the greatest practical importance to perform the processes of impregnation in the *very shortest possible time.* Some operators mix the milt first with water, and then immediately drop the spawn into it, believing that the minute currents, formed by the absorption of water by the egg, have the effect of directing the movement of the animalcule toward the orifice. It is also supposed that the swelling of the egg, in consequence of the absorption of water, tends to close the orifice, so that the animalcule cannot enter, after the envelope is full of water. However this may be, it is found, by experience, that the *simultaneous* mixture of the milt and the spawn is most likely to effect the impregnation of the greatest proportion of the eggs; and hence it is recommended, when practicable, that *two* persons should work together, one manipulating the male fish and the other the female.

6. It is absolutely necessary that the ova be *mature.* Fish do not deposit all their spawn at once, but usually through several successive days, as the eggs become ripe. The operator should, therefore, use no violence in forcing the eggs from the female; since those which are fully mature, and fit for impregnation, will fall from her with very little pressure. After she has emitted that portion which is fully ripe, she should be placed in the tank again for a day or two, when a second portion will be ready for impregnation. The milt of a single male is usually sufficient for the eggs of several females; and it may be obtained likewise in successive portions.

7. An apparatus for enabling the fish to spawn naturally, thereby obviating the necessity of taking them into the hand at all, has been used in France. It consists of a sort of double-bottomed cage, the upper bottom being an open frame-work of wire, the lower a movable sieve of metallic cloth. It is suspended in the water of the pond, and the male and female fish placed in it. The female, by rubbing against the bars of the open-work floor, emits her eggs, which fall through upon the sieve below, and are impregnated by the male in the same way. We are not definitely informed as to the success of this contrivance, but it may easily be tested.

8. After the eggs are fecundated, their hatching still requires care. The essential points are an abundant supply of well aerated water, at a proper temperature, removal of unsound eggs, and protection against insects and parasitic mildew or fungus. Since light is indispensable to the production of this destructive microscopic vegetable, it has been recommended to keep the eggs, during hatching, in darkness. Different species require different degrees of warmth. The eggs of the trout will bear a temperature nearly as low as 32°, but would be destroyed by remaining in water as high as 55°. They require the purest water; and that of a running spring, or stream, which can be constantly renewed, is best. If this cannot be had, filtered water is recommended. The eggs should be examined once or twice a day, and every one which shows the least degree of disease, indicated by the opaque, whitish color of its yolk, should be removed with a pair of small tweezers or forceps. The accumulation of sediment which would be likely to breed mildew, should be also removed, by passing over the eggs a soft hair pencil. *During the first few days of development, the spawn should be agitated as little as possible,* since it is at this period that the foundation of all the organic processes and of the whole structure of the fish is laid. After the eyes of the young fish begin to be visible through the egg-shell, appearing like two disproportionately large black dots, the egg is much less sensitive to rough treatment, and may be handled, or transported to a distance, with less risk than at any other period of its development.

9. As to the hatching apparatus, it may be said that any is good which admits a free circulation of water, excludes rapacious enemies, and permits ready access to the eggs, and the easy removal of such as may become infected. A very successful operator, Mr. Knoche, thus describes the apparatus used by him:

"For a breeding chest, I employ a stone trough seven feet long, two feet broad, and one foot deep, and provided with a wooden cover fitting into a rabbet, and secured by a lock. To one end of the cover is nailed a frame, whose length is equal to the breadth of the cover, and which is four inches wide and five inches deep, forming a small trough placed across the cover of the large one at the upper end. Within this frame several holes are bored, through the main cover, so as to allow the water, supplied from above, to pass into the trough. A piece of coarse linen cloth is nailed across the frame, and through this all the water which enters the trough is strained. Within the breeding-trough there is a perforated box, which distributes the water received from the frame evenly and quietly through the trough. At the opposite end of

the trough, six inches above the bottom, are two square holes, covered with finely-perforated tin plate, and so adjusted as to permit the escape of the same quantity of water as is admitted through the frame. The trough is sunk in the ground, near a spring, which is raised by a dam to the height of a foot, and the water is conducted directly to the middle of the frame, on the cover of the trough, through a pipe about an inch and a half in diameter. The bottom of the trough is filled up to the depth of three inches with clean-washed sand, or gravel, and the water always stands three inches deep on the sand. When the eggs are to be introduced, the flow of water from the spring is shut off, and the impregnated spawn, after standing three hours, is carefully poured into the trough, and so distributed that the eggs are not in contact with each other. The distribution is effected, *without touching the eggs*, by agitating the water over them with the bearded end of a quill. The trough is now closed, *and left undisturbed for twelve hours*, after which the water from the spring is again admitted, and kept regularly flowing."

This process may be greatly varied according to circumstances, as in the cellar experiments of Mr. Kellogg. Like the latter, Drs. Mayor and Duchosal, of Geneva, used the common drinking water from the public reservoir. They placed the eggs in square earthen pots, arranged on the steps of a stand, like those used for flower pots.

Each pot had a small aperture in front, into which was introduced a pipe, to convey the water to the next tier below, and so arranged as to keep the water in all the pots one inch deep. The pipe from the reservoir was pierced with holes, corresponding to each pot in the upper tier; these pots, which were about a foot square, received a constant stream of about a line in diameter, directly from the aqueduct pipe, and the lower pots received their supply from the tier next above. The eggs hatched equally well in all; but, from the partial exhaustion of the air in the water in passing through the upper tiers, the eggs in the lower tiers were somewhat longer in hatching. Other contrivances, adapted to peculiar contingencies, will be readily suggested to persons of ingenuity. For hatching eggs in spring or summer, flat-bottomed earthen pots may be used, with small holes in the sides, about an inch from the bottom, so as to admit a free circulation of water. These may be inserted in small rafts, made of wood, and thus left to float in the current, the rafts being secured by a cord, so that the pots may be drawn to the bank at any time for examination. No gravel would be necessary in these pots.

10. After the exclusion of the young from the eggs, so long as the yolk-sac remains attached to the abdomen of the fry, little attention is required. It is well to remove them to a larger receptacle, as a long trough, with a foot of water, to allow them space for their movements. A floating box may be used for this purpose, so loaded as to swim horizontally, and moored so that the current of the water will pass through it from end to end, fine wire net-work being fixed at each end to prevent the escape of the brood.

11. After the yolk-sac is exhausted, the young fish require food. Small insects and larvæ form their principal natural nutriment, and these abound in every brook and pond, so that the fry may usually be

left to take care of themselves for awhile. The pond into which they are admitted should be carefully cleansed, and should not contain any of the larger fish. A small stream running into the pond, up which the young can proceed, would be peculiarly favorable for the prosperity of trout. Left thus to themselves, Mr. Knoche has generally found about half the original number at the end of the year, the rest having perished or escaped. When little water can be commanded, and only small artificial reservoirs can be used, feeding becomes necessary. Small trout devour with avidity coagulated blood, boiled or dried flesh, fragments of boiled fish, or any other animal substance which can be divided into fine fibers, thus resembling worms while sinking in the water.

12. It is important to determine what particular species should be selected for artificial breeding in particular localities. As a question of profit, it is obvious that we should breed the kinds most valued in the market for which they are bred, commanding the highest price, and best accommodated to the natural or artificial conditions at the disposal of the breeder. If fish from distant localities promise a better return than native species, they may be introduced. On these points no precise rules can be laid down. The introduction of fish from remote localities is not difficult. The best period for transporting the eggs is, as already noticed, when the eyes of the embryo appear through the shell.

13. Of the success of private operations, where the breeding is artificially conducted from the spawning to the market, an opinion may be formed from the following statement of Mr. Knoche:

"For the last six years I have hatched, annually, about eight hundred fish (trout) from a thousand or twelve hundred eggs. At the end of a year from hatching, I seldom find more than half that number in the pond, the rest having perished or escaped, probably the latter, as it is very difficult to make a pond so tight that the fry cannot sometimes pass out, at either the inlet or the outlet of the water. My fish, in general, thrive well, and for the last three years my ponds have supplied, annually, from three to four hundred artificially-bred trout, of three and four years old, those of the latter age weighing from three quarters of a pound to a pound."

FISH AS AN ARTICLE OF DIET.

It is generally admitted that fish supply an article of diet at once palatable, nutritious, easy of digestion in most cases, and conducive to good health. But what are their nutritive qualities as compared with other kinds of animal food? whether different species of fish differ materially in degree of nutritive form? and whether, as food, fish possess any peculiar or special properties? These are questions of great interest to consumers of fish, but to which it is even yet difficult to give a satisfactory answer. An inquiry into these points was made, a few years ago, by Dr. John Davy, inspector general of army hospitals, &c., the results of which he read before the Royal Society of Edinburg. Taking for granted the proposition "that the nutritive power of all the ordinary articles of animal food, at least of those composed

principally of muscular fiber, or of muscle and fat, to whatever class belonging, is approximately denoted by their several specific gravities, and by the amount of solid matter which each contains, as determined by thorough drying." Dr. Davy subjected portions of several species of fish, and also several kinds of meat and other alimentary substances, to the test of very accurate processes, in order to ascertain their several nutritive powers. The following tables show some of the results, the fish, selected from those upon which Dr. Davy experimented, being either common to both shores of the Atlantic, or quite similar to fishes known by the same name among us:

TABLE 1

Species of fish.	Specific gravity.	Solid matter, per cent.	Time when obtained.
Haddock	1056	20.2	August.
Hake	1054	17.4	October.
Pollock	1060	19.3	October.
Whiting	1062	21.5	March.
Common cod	1059	19.2	April.
Mackerel	1043	37.9	October.
Salmon	1071	29.4	March.
Trout	1053	22.5	March.
Trout	1050	18.7	October
Smelt	1060	19.3	March.
Eel	1034	33.6	June.

TABLE II

Kinds of food	Specific gravity	Solid matter, per cent	Time.
Beef, sirloin	1078	26.9	March.
Veal, loin	1076	27.2	November.
Mutton, leg	1069	26.5	November.
Pork, loin	1080	30.5	January.
Common fowl, breast	1075	27.2	November.
Grey plover, breast	1072	30.1	November.

"These results," says Dr. Davy, "I wish to have considered merely as approximate ones. Casting the eye over the first table, it will be seen that the range of nutritive power, as denoted by the specific gravity and the portion of solid matter, is pretty equable, except in a very few instances, and chiefly those of the salmon and the mackerel; the one exhibiting a high specific gravity, with a large proportion of solid matter; the other, a low specific gravity, with a still larger proportion of matter, namely: muscle and oil, and, in consequence of the latter, the inferior specific gravity."

Oil also abounded in the eel, and hence the large amount of residuum it afforded.

Comparing, *seriatim*, the first table with the second, the degree of

difference of nutritive power of those articles standing highest in each, appears to be inconsiderable, and not great in most of the others. Thus the salmon, the mackerel, and the eel contain more solid matter than beef; and the specific gravity of salmon is greater than that of mutton. These results are certainly surprising, and not in accordance with popular and long-received notions.

"That fish generally are easy of digestion," proceeds Dr. Davy, "excepting such as have oil interfused in their muscular tissue, appears to be commonly admitted as the result of experience—a result that agrees well with the greater degree of softness of their muscular fiber, comparing it with either that of birds or of the mammalia, such as are used for food. A more interesting consideration is, whether fish, as a diet, is more conducive to health than the flesh of the animals just mentioned, and especially to the prevention of scrofulous and tuberculous disease. From such information as I am able to collect, *I am disposed to think that they are.* It is well known that fishermen and their families, living principally on fish, are commonly healthy—may I not say above the average? and I think it is pretty certain that they *are less subject to the diseases referred to than any other class, without exception.*"

This statement is proved by reliable statistics, collected with care by Dr. Davy, who proceeds to remark that if this exemption be mainly owing to diet, and that a fish diet, it may be presumed that there enters into the composition of fish some element not common to other kinds of food. This element is believed by him to be *iodine*, distinct traces of which have been found in every instance in which he sought for it in sea-fish, though not so strongly marked in the migratory fish, and not at all in the fresh-water fish. The medicinal effects of cod-liver oil in mitigating, if not in curing, pulmonary consumption, appear to be well established, and as this oil contains iodine, the analogy seems to strengthen the inference that sea-fish generally may be alike beneficial.

In concluding this imperfect notice of fish culture, which we hope to follow by a second in the next Report, we refer those readers who may have become interested in the subject, and who may desire to obtain further information as to many points upon which the space here accorded will not permit us to be more explicit, to two works, which are easily accessible to American readers, and which they will find useful assistants in practical fish breeding. They are, "A Complete Treatise on Artificial Fish Breeding," &c., published originally in 1854, by D. Appleton & Co., New York; and "A Treatise on the Artificial Propagation of certain kinds of Fish," &c., by T. Garlick, M. D., published at Cleveland, Ohio, by Thomas Brown, 1857.

ENGLISH PLOWS AND PLOWING.

BY HENRY F. FRENCH, OF EXETER, NEW HAMPSHIRE.

Even a casual observation of the operation of plowing in England must suggest to an American farmer a series of questions for solution, respecting both the form and structure, and the mode of use of the plow. The plows made by Ransome and Simes, which I saw on exhibition at the shows of the Royal Agricultural Society, and of the Suffolk County Society, perhaps rank as high, at present, as any plow in England. I was informed, at the warehouses of the manufacturers, at Ipswich, that their plow in common use as a seed plow, for two horses, weighs two hundred and eighty pounds, and its length is twelve feet. It turns a furrow of eight or nine inches in width, and five or six in depth, which may be increased to one of ten by seven inches.

Actual experiment, at the warehouses in Boston, shows the average weight of American plows designed for the same work, with wheel and cutter, to be about two hundred pounds, and their average length about seven and a half feet.

The English implement is entirely of iron, of fine workmanship and finish, with two wheels, and is much less simple in its structure than the American; yet the American plow seems to be more firm and strong than the other. Indeed, the extreme length of the handles and of the beam of the English plow, notwithstanding they are of iron, gives to a hand accustomed to the American implement a feeling of insecurity, as if the material were elastic, and would not be stiff enough to control the work were a stump or fast rock to be encountered in the furrow. This apprehension, however, is idle in most English fields, which for a thousand years, perhaps, have felt the pressure of the plowshare.

But the difference between English and American plowing is fully as striking as that between the plows. The worst-plowed field which I saw in a summer's ramble through old England might be said, literally, to appearance, to be done better than the best-plowed field that can be found in a New England farm. There seems to be no such thing in England as a crooked or irregular furrow, but, however extensive the field, the work appears uniformly as straight as a line could be laid down by a civil engineer with his instruments; and whether the operation be really more thoroughly performed than with us or not, it has at least the merit of being accomplished precisely as the plowman desires.

Our first impression upon these observations would naturally be, that notwithstanding the English plow is more clumsy and expensive than the American, yet that the former must have advantages of structure, which, for use in old and thoroughly-tilled fields, at least, more than compensate for these objections. Yet this, however natural, would be a hasty conclusion.

Within twenty miles of Ipswich, where Ransome's highly-finished

plows are manufactured, in a week which was spent on a farm and among intelligent farmers, in the county of Suffolk, an entirely different plow was generally in use—an implement so ungainly, so large and ill-fashioned, that it seems as if it must have been disinterred with the stone coffins of the Norman knights, which occasionally turn up in that neighborhood, or have been found in the antediluvian deposits of coprolites, for which Suffolk county is famous.

The plow referred to is that which is usually known in English books as the Norfolk plow, the peculiarities of which are, that it has but one handle, and that its beam, running upward at an angle of about forty-five degrees from the level surface of the ground, rests upon a frame-work supported by an axle, upon which are two wheels of about the size of the small wheels of a Yankee wagon.

This is one of the oldest forms of the plow now in use. A drawing of it may be found in Gregory's Dictionary of Arts and Sciences, published in England, in 1807, under the title "Husbandry."

The following extract from the same article will indicate primitive notions which its writer entertained on the subject of plowing. They are hardly less antiquated than the implement in question:

"Upon all light soils," he says, "it is necessary to preserve, at six or eight inches below the surface, what farmers call a pan, that is, the staple at that depth should be kept unbroken, by which means manure will be kept longer on the top; and, in dry seasons, the less depth the pan has, the less liable the corn will be to burn, provided the pan consists of earth and not of rock, because the roots of the corn will find more moisture by striking against a body of close earth than they will in a greater depth of wallow earth, as it is evident the former preserves more moisture in dry seasons."

A drawing of "the original two-wheeled plow," described also as the Hertfordshire plow, may be found in the "Compleat Body of Husbandry," the second edition of which was published in 1758. It does not appear, from this edition, when the first was published, but the engravings, said to be from original drawings, appear very ancient. This "original two-wheeled plow" there figured, is very nearly like the Norfolk plow, as shown in Gregory's Dictionary, and that now in common use in Suffolk county.

Those which I saw were of such style of workmanship and finish as common mechanics on a farm would be likely to give to their productions. They certainly had no claim to the beauty of simplicity, or to the higher beauty of scientific adaptation to the purpose of their creation; yet the work done with this implement, so rude and so ancient, seemed, in the skillful hands of English plowmen, to be just as straight and even as that performed by the polished and modern, and more artistic product of Mr. Ransome's shops.

And thus we have the mystery of English superiority in plowing solved, by the superior skill of English plowmen, without necessarily admitting the superiority of English plows. A plowman in England is a plowman always. Destined for that position from his birth, if not long before predestinated to it, embarrassed by no hopes or aspirations for a higher station in life, he takes hold of the plow-handle in his early youth, he practices in that more equable climate almost every

day of every month in every year of his life, to perfect himself in this one operation. Trials of skill, in which small pecuniary rewards, or the praise of his employer, are accorded to the winner, for the best performance in the plowing match, are not unfrequent; and so, by the division of labor incident to large farms, and by a manual dexterity and accuracy which only long practice can give, the English plowman, with the implement, whatever its form, to which he is accustomed, produces, on the particular farm to which he is attached as a laborer, a result which challenges the admiration of all.

The question, however, between the English and American plows of modern construction is still open: Does the weight or the length, or does any other peculiarity of the English plow, upon the whole, contribute to the utility of the implement?

It may be said that differences in the soil, or the condition of the surface, render any such inquiry fruitless to us, because a plow that may be suitable and best for old fields in England, may be quite unfit for the newly-cleared lands of the New World. Such, manifestly, is the fact, but much of this New World has already been converted into broad, clear fields, and much of our best alluvial and prairie land becomes, by a few years' culture, as free from obstructions as the oldest fields of Europe.

And again, as has been stated, the English plow, of whatever form, is of far greater weight than any American plow, and should, therefore, other things being equal, possess, proportionably, a greater strength, and so be suited to heavier work.

Had we found the American plow the heavier of the two, it would have been at least a plausible explanation that our new lands require a heavier and stronger implement than those of a country already thoroughly subdued.

The very great diversity of structure of the various plows in use in England itself has not failed to attract the attention of scientific agriculturists, as well as of plow manufacturers in England, for it is manifest that the difference in the structure of the plows in use in the different sections of that country cannot be accounted for upon the idea that the difference in soil and crops require the use of implements so diverse, especially when it is known that, throughout the varying climate and soil of Scotland, there is but one form of plow in use, or rather it should be said, there is in Scotland, in the plows in use, no variation in principle, and but little in detail. In England, on the contrary, with no greater variation of climate or soil, there are in use, almost side by side, plows varying from each other in structure as much as any of them are distinguished from those in general use in the United States.

Although, at various times, ardent advocates for progress have announced that the plow was soon to be superseded by some implement that shall stir the ground by forking or digging, propelled either by steam or beasts, as may be convenient, yet it is probable that an implement which, for two thousand years, and probably much longer, has retained its position as the first and most important agent in preparing the soil for the seed, will remain in use long and extensively enough to warrant a careful study of its structure and mode of opera-

tion. It is proposed, therefore, to examine some experiments that have been recently made in England, with a view to ascertain the effect of the weight and different structure of the plow upon its draft.

It is a fact well known to practical farmers, that the draft of different plows, turning the same width and depth of furrow, in the same field, and performing the work in substantially the same manner, varies so much as to be plainly practicable in its effect upon the team. The use of the dynamometer, by which the power exerted upon the plow, or, in a word, the draft can be actually measured, has confirmed and made definite this point, which before rested upon conjecture, or mere estimate. It has thus been ascertained, by a trial of ten different plows, each of a different make from the others, that the difference in draft, in performing precisely the same work, amounted to forty-five per cent. The experiment was made in turning a furrow with each plow, nine inches in width by five inches in depth, in five different kinds of soil, and noting carefully the results as shown by the dynamometer. Taking the average of the five trials, it appeared that, while the plow of lightest draft required a power of three hundred and one pounds to work it, the plow of heaviest draft required a power of four hundred and forty-one pounds to perform precisely the same work, and the other eight required the greatest possible variety of power between these extremes.

At a trial reported in the transactions of the New York State Agricultural Society for 1843, page 61, it was found that the average of resistance, or the draft of twenty-four different plows, tested by the dynamometer, ranged from two hundred and ninety-eight to four hundred and eighty-three pounds, showing that more than sixty per cent. more power was required to move one plow than the other, in the work of turning a furrow twelve inches wide by six inches deep.

In another series of experiments, in the transactions of the same society for 1849, page 559, in a trial of twelve different plows, we find the draft to vary all along from two hundred and ninety pounds to four hundred and ninety-three pounds, being a difference of seventy per cent. in performing the same work of turning a furrow of twelve by six inches.

Surely differences so great as these in the labor expended in the use of the most common and indispensable implement known to farmers, call for the most careful examination of causes, and the fullest exposition of principles and results.

The writer is not aware that any very reliable experiments have ever been instituted to test, by the dynamometer, the comparative draft of English and American plows. A statement of such an experiment at the World's Exhibition at London, in 1851, is found in the transactions of the New York Agricultural Society for that year, but neither the width nor depth of the furrow is given, and the draft is so great, if we are correct in supposing the words "*points* of resistance" to mean *pounds* of resistance, as clearly to indicate that the trials were not well conducted. The attention of the plow makers has generally been turned to the form of the mold-board, perhaps more than any other point, in their attempts to construct plows of easy draft. This is doubtless an important consideration as well with

respect to light draft as to good work, but the system of experiments under consideration seems to indicate that far less depends upon the exact form of the mold-board, as to the draft, than has generally been supposed, and that the weight of the implement itself, and the resistance to the coulter in cutting the furrow-slice, affect the draft far more. And the same experiments furnish results, which will probably be surprising to all who have not witnessed or read of similar trials, as to the effect upon the draft, of the use of wheels upon plows, either under the beam or sole-plate, as to the effect of the depth of the furrow, and as to the influence of velocity on the draft.

For the sake of system and convenience of reference, the results of such well-conducted experiments as have come to my knowledge, with such suggestions as have occurred to me, or been gathered from reliable sources, will be given under the following arrangement:

1. The influence of the weight of the plow on its draft.
2. The relative influence of the mold-board, or turning process, and of the share and coulter, or cutting process, upon the draft.
3. The influence of the depth of the furrow upon the draft.
4. The influence of velocity on the draft.
5. The influence of wheels of various kinds on the draft, and their utility.
6. The effect of the length of the various parts, as the beam, the mold-board, and the handles, upon the operation of the plow.

First. *The influence of the weight of the plow on its draft.*

We are accustomed, perhaps, to regard the weight of the plow rather as affecting the convenient and easy handling of it to the plowman, than as of much importance to the labor of the team. We readily perceive that it is far easier to take from the tool-room, to place in the cart, to take out again and place upon the land, an implement of one hundred pounds weight, than of twice that weight.

All who have held the plow know practically how much more convenient a light plow is than a heavy one, in setting in and throwing out at the end of the land; and especially does a farmer upon a rough farm appreciate this difference, where, as, indeed, on many New England fields, the plow is thrown or lifted out, and set in, at almost every rod of its progress, to avoid stumps, or stones, or roots of some almost imperishable tree, felled, perhaps, a half century ago. Few, however, will be prepared for the results which have been developed by the experiments now on record. A little reflection will satisfy us that the draft of the plow is composed of two elements, one of which is the mere force necessary to move the plow, resting on its sole, in an empty furrow, or on the surface of the ground, and the other force necessary to cut and turn the furrow, or do the work of plowing. The heavier the plow the greater the force necessary to move it along the surface. In a series of experiments published by Mr. Pusey in the English Agricultural Society Journal, it appears that the average draft of nine different plows, in an empty furrow, was in proportion to the weight as three to four; that is to say, that a plow of three

hundred pounds weight required a force, as shown by the dynamometer, of two hundred and twenty-five pounds to move it, when not at work. By the same experiments, it appears that the average draft of the same plows, working and turning a furrow nine inches by five, was a fraction less than double their draft in the empty furrow. Later experiments confirm this result; and it may be taken as demonstrated that, in the use of the heavy English plow, about one half of all the force of the team is expended in moving the implement, when at ordinary light work!

Weights being put upon the plows, the trials were repeated several times, the weights upon each plow being increased, and also the depth of furrow.

An examination of the carefully-arranged tables given as the result of these experiments, seems clearly to establish that the weight of the plow is a constant element in the draft; so that, if a plow require two hundred pounds more force than another to move it in an empty furrow, it will, other things being equal, require the same additional two hundred pounds of force to move it when at work, at any depth, in any soil.

Taking, then, the draft of the plow in the empty furrow, which may be called the surface draft, to be three-fourths of the weight of the implement, and the weight of English plows for common work to be that given me at the factory of Ransome & Simes, two hundred and eighty pounds, and that of the American plows to be one hundred pounds, we have the difference in the draft, one hundred and thirty-five pounds, or three-fourths of the difference in weight.

When we consider that about one-half of the draft of the English plow is expended in merely moving it, we see that, either by accident or science, we have, in the United States, made a decided improvement upon the mother country in the reduction of the weight of this implement. No means are afforded us of estimating their comparative strength, but from observation and information obtained on English farms, my impression is that the compact and simple structure of our plows renders them less liable to break or get out of repair than the best modern iron plows of English manufacture. How the greater length of the mold-board affects the draft of plows may be better considered after examining our next point.

SECONDLY. *The relative influence of the mold-board, or turning process, and of the share and coulter, or cutting process, upon the draft.*

The soil upon which the experiments, of which the results are now to be stated, were made is described as a deep, firm, steady loam, free from stones—a one-year-old clover bed. The trials were made by first measuring the draft of the plow when at work in the ordinary way, and then by removing the mold-board, and leaving the share and coulter to do their work of cutting, without the furrow. The furrow, in this trial was nine by six inches. The whole draft of the plow at work was thirty-four stones. The removal of the mold-board diminished the draft only to thirty-one stones, so that three stones only, or ten per cent of the whole draft, seemed to be occasioned by the mold-

board. The surface draft of this plow was twelve stones, and subtracting that from thirty-one, we have nineteen stones as the labor of cutting the furrow-slice.

Analyzing the process thus far, if those experiments are correct and reliable, as the foundation for general estimates, we find that about thirty-five per cent. of the labor of plowing, at the depth of six inches, is expended in moving the implement, about fifty-five to the operation of cutting the furrow-slice at the bottom and side, and only about ten per cent. to the action of the mold-board, or process of turning the furrow. It will be observed that, in these experiments the furrow is deeper by one inch than in the former experiments, where the result showed the surface draft to be about fifty per cent. of the whole labor. A further statement will show that this variation in the depth of the furrow will just about account for the difference between thirty-five and fifty per cent. set down as the surface draft in the two cases.

Thus we are brought to the consideration of the third point proposed:

THIRDLY. *The influence of the depth of the furrow upon the draft.*

From the sort of natural desire which men have to establish some principle, rather than because there was any evidence of such a law, it has been supposed that the draft of the plow increases with the depth of the furrow, in mathematical proportion, that is to say, according to the squares of the depth.

But the investigations already made, though far from satisfactory as establishing any principle or law of increase, are conclusive upon the proposition that the increase of draft is far less than the proportion named. Much depends upon the form of the plow, and whether it is made, in these trials, to work much deeper than its design or structure warrants.

Much depends, also, upon the subsoil, and especially upon the question whether, in the experiments upon this point, the plow is run at a depth so great as to strike into the hard pan, or stratum, upon which the plow sole has, for many years of tillage, run; and more than all, perhaps, depends upon the particular work in hand, whether it be in a tough sward or in an old field. The English experiments were tried in a clover field of one year, where there could be nothing like the matted turf of our mowing lands. Taking the average of their trials, with different plows, it was found that it required an increase of power of about ninety pounds, upon increasing the furrow from four inches to six, and an increase of power of three hundred pounds to run the plow eight and a half inches deep. An examination of the details of these trials seems to indicate, what, perhaps, might be anticipated, that the greater the draft of the plow, in a shallow furrow, the less its increase of draft in the deeper furrow.

This may readily be accounted for upon the idea that the heavier plows, used in the experiments, were intended, and properly constructed for deeper work. From all the results yet published, it would be fair to infer, that an increase of depth, not beyond the reasonable capacity of the implement, involves an increase of drafts less than half

that stated in the books as the rule; that is, according to the squares of the depth.

FOURTHLY. *The influence of velocity on the draft.*

We are accustomed to associate the idea of increased speed with that of greatly increased power. With regard to ships, canal boats, and the like, it is considered a general rule, that in doubling the velocity of a body moving through a fluid, that body not only impinges on twice as many particles of the fluid, but on each of them with twice its former force; so that the resistance increases as the squares of the velocity. The velocity of locomotives upon railways is limited by various circumstances, so that it is well understood that a low rate of speed is far more economical than a higher rate. But the resistance opposed to the plan in its work is mainly attributable to one principle, that of friction, and it is a well established proposition that friction is not, in general, increased by an increase of velocity.

In accordance with this principle, the results of careful experiments, with the dynamometer, with the same teams and plows, at various rates of speed, indicate no difference whatever in the draft of the plow, when at work at the speed of one and a half miles, and three and a half miles per hour. It was found, however, that although the average draft was substantially the same, at any rate of speed between one and a half and five miles per hour, yet that the oscillations in draft were greatly increased, that is to say that the draft at a slow rate was more regular than at a higher rate of speed. This is readily accounted for, because of obstructions in the soil. A stone, for instance, upon which the plowshare should strike with double the usual velocity, would cause a momentary increase of draft, followed by a decrease, as the plow should slip past it. The principle thus practically established, that increase of velocity in plowing involves no increase of draft, is of the highest importance, as respects the question whether slow or fast moving animals should be employed in this work. An ox-team, moving at the rate of one and a half miles per hour, will plow an acre, turning a furrow nine inches wide, in seven hours and twenty minutes; while a horse-team, moving at the rate of two and three quarter miles per hour, will accomplish the same work in four hours, and the actual power exerted on the plow is the same in both cases. Hence the importance of employing active animals in all labor of this kind for which they are suited. Slow animals, like oxen, cannot, with or without a load, be driven rapidly; but within the natural walking pace of the animals employed, there seems to be an actual waste of power in proportion to the increase of the time employed upon the plow, or, in other words, the same force is exerted every moment of eight hours in plowing an acre, at a given width and depth of furrow, as is exerted in the four hours in which a horse-team may perform it, at a fast walk. There is, however, another element which cannot be estimated by the dynamometer, or any other instrument, yet should enter into our consideration of this topic. Every animal, in moving, with or without a load, carries the burden of his own body, and it is probably true that this burden is somewhat in proportion to his weight, and to the speed with which he moves.

To illustrate this, we have only to look at the facts developed by the use of the dynamometer in plowing over hills. It is found that the draft of the plow is very little varied by plowing up or down a descent, while every farmer knows very well that his team walks much harder in ascending than in descending.

So if a team be driven up a steep hill without a load, the animals obviously exert themselves more than in moving at the same pace on level ground. The greater difficulty of ascending may be partly accounted for upon the common principle of gravitation. In raising himself to the top of a hill, to a position twenty feet higher than he before stood, the animal has exerted as much power, in addition to his effort on the level, as would be, mathematically, necessary to raise the same dead weight the given height in the same time; and something more may be added, for the distorted action of the muscles, and in plowing for the disturbance of the true line of draft. Even upon level ground, it requires some exertion for any animal to move, and this exertion is probably proportioned, in some measure, to the rapidity of the motion. Any calculation upon this point, based upon the difficult theories of momentum would be of no practical value. Assuming, as we may, upon the facts disclosed by the experiments referred to, that the draft of the plow is not substantially increased by the velocity of its movement, it is for the farmer to consider the natural pace of his animals, the saving of time of his laborers, as plowmen or drivers, by rapid work, the increased danger of injury to team or implements, where the ground is obstructed by stumps or stones, and make the best practical use of the developments of science made for his benefit.

FIFTHLY. *The influence of wheels of various kinds upon the draft, and their utility.*

The greater part of the plows used in England are supported by two wheels, one on each side of the beam, usually arranged so that one wheel runs in the furrow and the other on the unplowed land, there being a difference in their radius of about the depth of the furrow. They are, however, separately adjustable, so as to be changed to gauge furrows of different depth. The theory, as stated to the writer by a farmer, who was defending the use of the old Norfolk plow with its high wheels, is plausible enough in favor of wheels. The draft of the plow, said he, results from its friction on the furrow-slice and on the bottom of the furrow, and whatever weight rests upon the wheels is taken from the sole of the plow, and relieves the draft so much as the difference between rolling and dragging friction. Various trials have from time to time been made in England with a view to determine the influence of wheels upon the draft. Mr. Handley's trials, reported in the Journal of the Royal Agricultural Society, made with four different plows, indicated an advantage from the use of wheels of about fifteen per cent. Mr. Pusey's experiments made the difference still greater, amounting to twenty-two per cent. in favor of the wheels. Mr. Morton, in a series of carefully conducted experiments, made with full knowledge of the previous trials by the other gentlemen named, arrives at the conclusion, that when a plow is properly set, the addition or removal of a wheel will make no material difference in the draft. There is a

difficulty in determining this point accurately. Mr. Pusey, in his trials, took off the wheels from a wheel-plow, and made the comparison between that plow, thus used as a swing-plow, and the same plow used with the two wheels which belonged to it. Now it is obvious that a plow properly constructed for use with wheels, and, of course, to rest a portion of its weight upon them, might be increased very much in its draft, by throwing that weight upon the sole of the plow, or otherwise gauging its furrow by the mode of holding, or of attaching the team to it, to prevent its burrowing too deep. On the whole, it is believed that the draft of the plow can be very little effected by the use of wheels. Most American sod-plows are used with a single small wheel, or truck, to gauge the furrows. Sometimes this is directly under the end of the beam, and sometimes by its side, and, so far as gauging the furrow is concerned, is almost indispensable, but it is not apparent why the draft of a plow should be diminished by throwing a weight on the wheels, if the plow could be so constructed as to run at the desired depth uniformly without such wheels.

It is manifest that with the wheels, or without, there is the same cutting process to be performed, which, as has been seen, causes more than half the draft; there is the same friction upon the mold-board, which must cause nearly, if not quite, the same pressure and friction on the sole; there is the same weight of the implement to be dragged, and, certainly, it would move more easily on wheels, if the plow were so constructed as to rest part of its weight on the beam, when not at work, which is not ordinarily the case. What gain that can be by so arranging the parts that the draft of the team shall bring a weight down upon the wheels which support the beam is not perceived, but it seems that the force which thus bears down upon the beam were better applied in overcoming the legitimate and unavoidable resistance of the soil to the plow in its proper work. If the wheels are useless, it is sufficient objection to them that they increase the weight and cost of the implement. If they are useful merely as a gauge of the depth of furrow, the single wheel, as being more simple and easily adjusted, and as being a lesser obstacle in handling the plow, especially in short work, seems preferable.

SIXTHLY. *The effect of the length of the various parts, as the beam, the mold-board, and the handles, on the operation of the plow.*

The English plows are, on an average, two fifths longer than American plows. There is an obvious reason why short plows must be used in the new lands of our country, and in the stony and uneven lands of New England. Where a stump is to be avoided in every ten feet, or a stone to be scaled at every rod; where the share catches a hinder root, and the team is to be backed every five minutes through the day, and the plow dragged backward by main strength; where it is to be set in again as often as it is thus thrown out, with a precision of aim equal to that required in rifle-shooting, manifestly nothing but a short, stiff, strong implement can possibly be used. For such land the long English plow has no pretense of fitness. But upon the old fields and bottom lands, upon the prairies, after they are once broken, there seems to be no reason why the same plows which would really be most suitable on English farms should not be here most serviceable

The additional length of the English plows seems to be pretty equally distributed between the handles, the mold-board, and the beam.

Great length of handles gives greater power in controlling the movement of the plow, and greater length of beam gives greater steadiness to the draft; yet the increased length of both these parts necessarily increases their weight, upon the principle of the lever, the greater the length the greater the strength to resist the power applied.

As to the length of the mold-board, it is frequently contended that the longer the curve which turns the furrow the less the resistance, the mold-board being regarded as operating as a wedge; but this idea is open to many objections.

This part of the subject, however, involves so many considerations, which belong rather to the plow-maker than the farmer, that it is hardly appropriate for discussion here. Whatever may be the true theory as to the length of the mold-boards, its increased length does not necessarily involve the increase of the length of the other parts. To the practical working of the long English plows, there is an obvious objection in the minds of all who have seen them at work in small fields. Horses are almost exclusively used there upon the plow, and are harnessed one before the other, and with greater length of draft-chains than we are accustomed to use.

As a consequence of this "long drawn out" establishment, a wide headland is left, utterly beyond the reach of the plow, so that where, in America, we back up and set in our short plow close to the fence, the English farmer sends a man with a spade to work a half day in finishing up the land. Where labor is cheap, as in England, this is of much smaller importance than it would be with us.

As a general summary of the matter, as to the comparative merits of the English and American plows, it is believed that we have improved greatly upon the models, in the lightness of our implement, in the less cost of it, and by dispensing with their more complicated arrangement of wheels. Whether, by shortening the whole implement about two-fifths, we have not sacrificed to our peculiar wants upon new fields something of the nice control which the length of beam and handle gives to the English plowman, is, at least, questionable. Whether we have gained or lost by our changes in the length and form of the mold-board, is still undetermined, and must remain so till both implements are tested, in the same field, by the dynamometer.

Finally, there can be no doubt that, generally, their plowmen have more skill in their business than ours in New England; and he must be a careless observer, or blinded by prejudice, who does not see that their labor in this important department is better performed than in our own country.

STEAM PLOWS IN ENGLAND.

Fowler's Steam Plow.

Steam cultivation is attracting great attention among the foremost agriculturists in England. The two steam implements which seem

now to dispute for supremacy are Fowler's plow and Smith's (of Wolston) cultivator. The former performs its work strictly by plowing, the latter, as the inventor elegantly expresses it, by "smashing up" the soil, by means of teeth operating like a spade to stir, without subverting the soil.

To Fowler's steam plow was awarded, at the exhibition of the Royal Agricultural Society, at Chester, in England, in 1858, the grand prize of £500, and at Warwick the new prize of £50, in 1859, which furnishes the best evidence we can have of the comparative merits of English implements, and entitles it to a prominent place in any article on the subject. At Ipswich, in England, on the 4th of July, 1857, I saw in operation Fowler's steam plow. Having previously seen, at the workshop of Ransome & Simes, the same implement, and having had its principles of operation carefully explained, I spent several hours with it, while actually at work upon a large field, where it had already plowed many acres. It was, while I observed it, turning furrows seven inches deep, by about ten in width, carrying three at a time, and performing its work as well as it could be performed in the usual way with horses. I carefully paced out the length of the furrows, and measured their depth and widths, and, with my watch in my hand, timed the operations. The machine was then plowing one acre per hour.

The arrangement was to use four plows and open four furrows at each passage across the field, and in that way the labor accomplished would be one third more. It is difficult, without drawings for illustration, to describe intelligibly the details of such an implement, but its general plan of operations may be readily understood. The plows are arranged in two gangs, of three or more, one gang at each end of a heavy framework, which is balanced across an axle, supported by two large wheels, like those of a heavy gun-carriage. This framework, with the plows, is drawn across the field by a stationary engine. As it is drawn northerly, for example, in its work, the frame which carries the plows is borne down, so as to lift the gang of plows at the northerly end high into the air, bringing down the southerly end, with its plows, so that they enter the soil for plowing. The depth is gauged, mainly, by a large wheel at each end of the framework, opposite the plows, which wheel is, in turn, lifted into the air or brought down to the surface, with the gang of plows to which it belongs.

Two men sat upon the machine, one to guide its motion, by appropriate machinery, the other to make signals with a flag, or do any other useful work that occasion might require. The engine in use was upon one side of the field, and was called a stationary engine. It was drawn to the field by horses, but had powers of locomotion sufficient, I think, to run itself along the headland. The plow was drawn *toward* the engine by a wire rope, which passed across the field, round a pulley, made fast at the opposite headland. This pulley was held by what was called an anchor, which anchor was in the shape of a four-wheeled low cart or car, loaded heavily with stones. The wheels of this car were of iron, and sharp at the edges, so that they cut down nearly to the axle. This anchor was drawn along the headland by a windlass,

worked by a man, in a direction at right angles with the furrow, so that the strain upon the pulley was at right angles with the track of the wheels. In justice to the inventor, it should be stated that he had already, it was said, constructed machinery, to be worked by the engine, to move the anchor, and so dispense with the man at the windlass.

It will be seen at once that this machine could only be of practical utility on level, clear fields, of large extent. It could only be used upon level fields of uniform surface, because the plows are set in an unyielding frame, and must run at the same level, thus running deeper across a hillock, and more shoal in a small depression. They are arranged not so as to be raised and depressed, each separately, as the machine is moving, but the whole gang is acted upon at once. Again, the machine would be of no use in a small inclosure, because of the broad headlands requisite to accommodate the engine on one side, and the anchor on the other.

It could be of little use in a field obstructed by stones, because of the inequalities of surface produced by them, and because, if one of the plows meets an obstruction too obstinate to yield, the power of the engine must generally be sufficient to break the plow, or, what is more common, the rope. The breaking of a plow must involve, at least, the necessity of a delay sufficient to detach it and substitute another, and such a delay of so large and expensive a force as we shall presently see is employed, must be of considerable importance. The breaking of the rope, which I was informed by the workmen was of frequent occurrence, is soon remedied by splicing it, but is, probably, a constant source of annoyance. As, however, it is impossible to foresee all obstructions, and the engine must exert great power, it is, perhaps, best to make the rope the weakest part of the machinery, as it is the most easily repaired.

The force employed in this operation, as I witnessed it, beside the engine, consisted of five men and a boy, namely, the engineer, who remained by the engine, a boy to carry coal, one man upon the plow to manage it, another man, who rode part of the time on the plow, and who ran along before it to remove pulleys or rollers over which the rope traversed, to keep it from friction on the ground, another man to tend the windlass and anchor, and the other to keep the rope in place, with a crowbar, that it might wind properly round the drums of the engine.

In estimating the value of such an implement as this, there are certain elements always to enter into our calculations. First. The amount of labor performed. A span of horses and a plowman would, in England, as a regular day's work, plow one acre of such land as that under experiment. They would work six hours, without feeding, and in that time complete the day's work. This is the practice, I think, in most of England as to working horses. Six plowmen and twelve horses would, for six hours, perform the same work as the five men and boy, and the engine, and all the machinery. But the engine would not then be fatigued, but might labor on, while the horses must rest. Still, taking into account the liability of complicated machinery and of so great a length of rope to accidents which must cause delay, perhaps the steam plow could hardly be expected to be actually at

work nine hours per day, any more than the horses. Second. The expense and time employed in moving the engine, and plow, and anchor to the fields of operation, and placing them in position. I did not see the engine or machinery moved with horses, but this item is worth a place in our estimate, both as to expense and time. Third. The cost of working, which has been already considered, but there is to be added to the cost of the labor already named, the expense of supplying the engine with fuel. Both the coal and water are of heavy freight, and must be conveyed to the engine by horses and men. Their cost, at the field, must depend so much on the locality that it is useless to attempt an estimate. Probably an additional pair of horses and a man would be usually employed to supply the meat and drink of the steam giant. Fourth. The cost of machinery, and of repairs upon it. It was said that this engine and plow could be furnished, ready for use, at £500, or $2,500. It would require an engineer to estimate the cost of repairs. Unless the machine could be kept in constant use, the interest on the cost would be a heavy item, and, in all cases, must be a constant element to be regarded. The engine would be adapted to other farm labor, such as threshing, grinding, and the like. Such engines are in constant and extensive use for threshing, through England, on large farms. The inventor of this steam plow had taken a large contract to plow for several proprietors, a practice which, perhaps, should be kept in view in this discussion, though the difficulty of moving the engine from farm to farm, in this country, would be far greater than in England, because our roads are not so well made.

Upon the best estimate that I have been able to make, it seems to me that Fowler's steam plow can never be made an instrument of general practical utility, either in this or in any other country. Perhaps a more competent person, with such data as has been furnished, may form an estimate more favorable.

Simplicity is usually economy, in agriculture especially, and there does not seem, upon the theory of this machine, any such promise of performance as to compensate for the great expenditure in its structure, and the numerous obstacles to its practical operation.

Since 1857, Fowler's plow has been extensively used in England, and may be said to be fairly introduced there, but it may be inferred, from the tone of agricultural writers and speakers as gathered from newspapers, that it is quite doubtful yet whether it is really a valuable acquisition to agriculture. Subsequent experiments seem to indicate that my own estimate of the performance of the plow was too large. A recent writer in the Mark Lane Express states that at one trial, which he witnessed, the plow turned seven acres in twelve hours, and another account gives ninety-six square rods per hour as the result of its labor.

It is claimed, however, that Mr. Fowler has recently greatly reduced the weight and cost of his machinery. The essential principle of a stationary engine and plows or cultivators worked by means of ropes and pulleys remains.

Boydell's Patent Traction Engine.

The question in England between stationary and locomotive engines for cultivation seems strangely enough to be going almost by default in favor of the former, while in this country there appears to be a general consent that only a self-moving engine is worthy of notice. Boydell's elephantine engine attracted great attention, and disputed the prize with Fowler's plow, at the Salisbury exhibition in 1858. It has, apparently, fallen far behind in the face of competition, and in a respectable English journal has been lately spoken of as a mechanical absurdity, which wears itself but hourly as it travels. This brief condemnation is full of import to American inventors, who are giving attention exclusively to locomotive engines, and whose chief embarrassment thus far has been that their machines all break down in every attempt at public exhibition. A brief description of Boydell's implement may be useful to us for warning as well as example.

This engine, as exhibited at Salisbury, was operated to draw six plows, opening six furrows across the field. It is distinguished from the other steam plows that have been mentioned by being worked by a locomotive, instead of a stationary engine, which works on the earth like some huge animal, puffing and snorting, and taking along its six plows with no apparent consciousness of effort. It possesses another peculiarity: that of laying down an endless railroad track for its wheels to run upon, and taking it up as it proceeds. Attached to the wheels of the engine are large flat blocks, six to each wheel, like rackets on a horse to keep him from sinking in soft ground, which are laid down in turn by the wheel in its revolution, and on which the iron rim of the wheel runs. This engine works about in a very intelligent sort of way, comes to the field from a common road, drawing its tender with coal and water, and even carries the extra clothing and dinner of the laborers. It turns readily at the end of the furrow, stalks off to its water tank when it is thirsty and helps itself to water, and when it is hungry or fatigued, goes for its own coal for refreshment. It is claimed that the same engine can draw your timber to market or the mill upon common roads, haul in your hay and grain, work your threshing machine, and, in short, do most of the work of the farm instead of horses. This machine was not, at Salisbury, doing such good plowing as Fowler's, but the quality of the work is not at present of such importance. It is not a question of mere plowing, it is a question as to the best mode of applying the power of the steam engine, whether as a stationary or locomotive engine, for it is obvious enough that when we have once found a convenient and economical power, plows, harrows, digging machines, or anything else may be worked by it. Boydell's engine is guided by a driver, who sets on the forward part, while the engineer rides, like a footman behind. Three double plows were, at Salisbury, attached to it by chains, and these were held by three men, who walked, following and holding the plows in the usual manner. Many of the objections to the stationary engine are obviated by this invention. No horses are required to move it from place to place, or draw its supply of food and water. The cumbrous

"anchor," with the long ropes, are here dispensed with; and if the adjustment of the plows, as used by Fowler, is found most convenient, there is nothing to prevent its adoption, and the drawing of his plows with this locomotive engine.

Smith's (of Wolston) Cultivator.

In the progress of all arts and sciences it is observed how principles, at one time deemed most vital, come afterward to be regarded as of secondary importance, and still later, again assert their original claim to attention. Pulverization of the soil was, more than a century ago, advocated by Jether Tull as the one essential to good husbandry, and he even regarded manure as valuable only as assisting to pulverize the soil by fermentation. In later years, chemistry assumed a conspicuous position in agriculture, and many have been inclined to regard more the constituent elements of plants and of artificial manure than the mechanical condition of the soil, like quack doctors, whose attentions are so much occupied by their specifics, that they entirely overlook the condition of their patients.

But now, after the practical failure of the theories of some distinguished chemists, agriculturists are again disposed to regard the physical condition of the soil as of primary importance, and the operations of drawing, subsoiling, and otherwise opening a greater depth of soil to the action of the atmosphere, and to the roots of the plant, engage the attention of the farmer. As land becomes more valuable, it is found more convenient to add another seed-bed to the field by preparing it *under* the shallow furrow turned by our fathers, rather than by annexing our neighbor's farm, in the covetous desire to possess all the land that adjoins our own. And so we are looking for more power to work our land deeper, and to pulverize it more thoroughly. In England, four or five plowings are considered an essential preparation for a good crop of turnips. In America, where labor is more costly and products usually cheaper, we the more need some more aids to our husbandry. Twig says that Romulus, in his distribution of the land, allotted two acres to each citizen, and that after the expulsion of the kings it was increased to seven. Columella tells us that the patrimonial estate on which Cincinnatus employed himself consisted of four acres! Yet we, whose single farms are larger than the city of Rome, with her seven hills, are plodding along, bound to the old notion that the plow used by the Romans, or at least its principles of operation, must be forever preserved. Every one knows how much better is the preparation of the garden by forking up and raking, than by turning with plows and harrowing; and the implement desired now in place of the plow is a forking or digging machine, that shall, at one operation, stir the ground to sufficient depth, leaving it as nearly as possible in the condition of a garden bed prepared with a fork. Such a machine has been attempted by Smith, of Wolston. At Salisbury, in 1857, when the Royal Agricultural Society repeated their offer of £500 for a steam-plow, Smith was excluded from the competition by the condition which made it essential that the *implement should turn the soil over*, while, as already observed, it is an essential feature of the Wol-

ston system that the soil should be "stirred and smashed up," and *not* turned over.

At the Chester exhibition, however, in 1858, Smith and Fowler being competitors, the prize of £500 was awarded to Fowler, and the gold medal to Smith. From Dickens's "All the Year Round" we give the best description that can be found of Smith's machine:

"Mr. Smith uses an ordinary agricultural portable steam engine, of from eight to ten horse power, which he fixes at one corner of the field, of from ten to twelve acres. In front of the engine is a windlass, or capstan, with two drums of a peculiar shape, with a coil of wire rope around it, and this rope is led over four anchored pulleys, one at each corner, and along each side of the field. The windlass attached to the fly-wheel of the steam engine by a driving band can be instantaneously driven in either direction. Four different plows, or cultivators, are used as occasion requires. To the bow of the one in use two ends of the rope are attached. An engine-driver, a man at the windlass, a plowman, an assistant to shift the pulleys, and a boy, are the staff required. The plow cultivator begins by traveling along the more distant side of the field, between the two anchored pulleys; at the end of the first journey the pulley in front is shifted, the engine is reversed, and in thirty seconds the plow is traveling back. And thus, by alternately shifting, bringing up each of the two most distant anchors, strip by strip, the whole field is 'smashed up,' in parallel lines, to the spot where the engine stands.

"His plow No. 4 consists of a very strong frame, in which are fixed three subsoil plows, with a pair of wheels in front to guide it, and above the center another pair, to regulate the depth. The shares for breaking up clay soil, in autumn, are set to work six or eight inches deep, (a depth impossible with horse-power.) The points of the shares become imbedded in the subsoil, and the whole mass, nearly a yard wide and six or eight inches deep, is torn from its position and more or less mingled together, leaving, for the most part, the weeds or grass, which it is desirable to destroy, near the surface. An implement of greater breadth and more shares, on light and moderately tenacious soils, has been made to move more than ten or twelve acres a day. But, for a description of the four Wolston cultivators, those further interested must refer to the inventor's own pamphlets and pictures. The obvious drawback of the system consists in the loss of power by the friction of the rope along four sides, and consequent induct friction. Common farm laborers have been repeatedly and easily taught the duties of Smith's system of steam cultivation. According to universal testimony, nothing can exceed the quality of the work and the satisfactory result in crops of all kinds."

It seems to be admitted that Smith's system requires two operations—the first to stir up and break the soil, and the second to pulverize it; the two operations being completed at *the rate of three and a half acres a day.*.

It is said that Smith, before 1859, had sold some thirty sets of his machinery to purchasers who were successfully working them.

The idea which has thus been advocated by Mr. Smith seems at about the same time to have possessed some ingenious agriculturist on the

other side of the Channel. In a walk near Paris, in July, 1857, I accidentally came upon a steam cultivator, or digging machine, in full operation. It was a locomotive engine, with, I think, twelve spades, or forks, working in pairs, on bent axles, from which the spades, if they may be so called, projected at right angles. My impression is, that each pair of spades struck the ground and entered it separately, each of the six pairs successively doing its work, as the locomotive traversed the ground, and thus forking up the soil to the depth of six or twelve inches, at the will of the operator, and four and a half feet wide. The machine was under examination by some commission at the time, and I was informed that no report had yet been made upon it, no patent secured, and that no description or drawing of it could be obtained. I took a great deal of pains, afterward, to obtain information, and, from my inability to do so, inferred that there were reasons why the inventor desired, at present, that his machine should not be made public. I was told upon the ground that the engine was only of three horse-power; but its performance indicated far more. It moved upon broad wheels, however, over the soft ground, which had been before stirred by it, and turned without difficulty, at the end of the furrow. The spades, I think, were upon three or four independent axles, and worked between the wheels of the engine. Doubtless, the invention will soon be made public, and a full description of it given to the world. With my inability to converse on a technical subject in the French language, I could not understand its details, and find it impossible to convey more than a general impression of the working of the machine.

AMERICAN STEAM CULTIVATORS.

In a glance at what has been done and attempted by Americans, in the way of cultivation by steam, we shall be struck with the predominant idea of "going ahead." While the greatest performance claimed for any English implement is one acre per hour, or eight or ten acres a day, we find American machines actually plowing an acre in ten minutes, and promising to plow sixty acres per day. With the motto, however, which is no favorite with us, of "*festina lente*," it would seem that more real progress might probably be made. For, we shall see that in nearly every attempt at operating these implements the experiments closed by the breaking of some part of the machinery. The United States Agricultural Society, in their premium list for the exhibition at Chicago, in 1859, offered their grand gold medal of honor "for that machine which shall supersede the plow, as now used, and accomplish the most thorough disintegration of the soil, with the greatest economy of labor, power, time, and money."

The medal was awarded to FAWKE'S STEAM PLOW, together with $3,000, offered by the Illinois State Agricultural Society, in connection with the Illinois Central Railroad Company; and thus this implement is placed, at once, at the head of the list of American steam cultivators, and claims our particular attention.

Fawkes's Steam Plow.

This is the invention of Joseph W. Fawkes, of Christiana, Pennsylvania. The striking peculiarities of this machine seem to be, that it is a locomotive, running on a large roller, or drum, six feet in diameter and six feet long, instead of wheels, the design being to obviate the ordinary objection to locomotives, that their wheels cut into the soil, and obstruct the motion. The engine draws behind it a gang of eight plows, as shown at Chicago, though it is manifest that the number is unlimited, and that cultivators, harrows, and other pulverisers, may readily be substituted; the great desideratum is, a locomotive practicable on a reasonable proportion of land, and, at the same time, cheap and durable. This machine, and Waters's steam plow, which was its only competitor, were both caused by the committee to run twice round the half-mile track at Chicago, and to turn a single furrow, within the inclosure. They were then taken to the smooth, open prairie, for final trial. The result, as reported by the Quarterly Journal of Agriculture, was, that Fawkes's implement plowed at the rate of one acre in seventeen minutes, or three and a half acres per hour, including turns, and the work was excellent. There was some detention by clogging of the plows, which may be easily obviated. It would seem that, after plowing about two acres, the steam got too low for the continuance of the experiment; and the committee suggest some improvement as expedient for increasing the power of the engine. The committee conclude by remarking, that while they "are by no means prepared to certify that Mr. Fawkes's plowing machine has reached the degree of perfection only to be had after much practical working on a farm, they do not regard its several weak points as invalidating its claim to public favor, for enough good work was done, in the two miles of furrow it run on Friday, to prove it to have great merit."

For the benefit of those who desire an understanding of the details of this implement, we add a description of it, by the committee of mechanists who conducted the recent trials of steam plows at the fair of the Illinois State Agricultural Society:

"To form a complete conception of this steam plow, let the committee recall the appearance of a small-sized tender of a locomotive engine. Let about half the forward portion of the sides and tank be removed. We now have something which resembles the body of Fawkes's machine. In the middle of the forward portion of the platform stands the upright boiler, which is about 6½ feet high and 4 feet in diameter, the fire-box and ash-pit being of course below the level of the platform, and the fire-door opening forward. The boiler contains 220 1½-inch tubes, which, computed together with the fire-box, gives 375 feet of fire surface. Steam may be got up in 15 minutes, although twice that time is usually necessary. The fuel may either be bituminous coal or wood. The cylinders are horizontal, 9 inches in diameter and 15 inches stroke, and are placed one on each side of the boiler. The pistons communicate motion not to the side-wheels, but to a drum or roller, 6 feet in diameter and 6 feet long, which, as the sides of the platform overhang its end, is comparatively out of sight. The drum is placed about mid-

way between the front and back of the machine; before it depends the fire-box, and over and behind it is the tank; so that when the boiler and tank are full they nearly counterbalance each other on the axles of the driving drum.

"This drum is composed of two iron heads or 'spiders,' and an intermediate one; to these, thick, narrow planks, cut like staves, fitting closely, are bolted and form the periphery. The adhesion is, therefore, produced by a surface of wood six feet long, which never becomes polished, and the bearing of which is always across the grain. There is no slipping; the machine is started and stopped instantly; and, except when propelling itself a considerable distance on turnpike or paved roads, the wear and tear is slight. This substitution of the driving-roller for the ordinary side-wheels wonderfully increases traction, and prevents sloughing in wet or yielding soil; while moderate irregularities of surface scarcely affect the onward march of the plow. Another great advantage is gained by the gearing of the drum. Instead of being attached directly to a crank on the axle of the drum, each connecting rod communicates motion to a pinion which turns easily, but without shake on the axle just mentioned; the pinion interlocks with a cog-wheel which, by a pinion on its axis, imparts motion to the cog-wheel bolted to the drum; the whole being so proportioned that six strokes of the piston cause one revolution of the drum.

"Increase of power and of control over the movements of the engines are secured.

"In front of the fire-box is a short tapering bow of sheet-iron, which serves as a seat for the fireman and a receptacle for fuel. The bow is supported by a body-bolt on a truck composed of two iron guide-wheels three and one-half feet in diameter and fifteen inches broad. The truck moves freely like the front wheels of a chaise, and is controlled by a steering wheel in charge of the engineer, so that the whole machine is turned as readily and as short as a farm-wagon. The engine is thirty horse power. The entire length of the machine is about 18 feet; its weight with water and fuel, 10 tons; and cost, including 'donkey' engine and pump, about $4,000. By this pump, water may be drawn from a well or creek, and the tank filled, or water forced from the tank to the boiler.

"The tank holds twelve barrels, sufficient for three hours' running. The plows, eight in number, are attached to one frame, which is suspended by chains, passing over grooved pullies, in two beams, projecting from the seat of the engine. These chains communicate to a windlass, in charge of the fireman in front, by which a gang of plows may be raised or lowered at pleasure, and the frame of plows is drawn by other chains, which are attached to the under side of the frame of the engine."

Waters's Steam Plow.

James Waters, of Detroit, formerly of Pennsylvania, is the inventor of a steam plow, which, at Chicago and elsewhere, has attracted much notice. It is thus well described by a correspondent of the "Country Gentleman:"

"This machine has four cylinders, $5\frac{3}{4}$ inches in diameter, the stroke of the piston being 12 inches. The boiler, which is the one used on locomotive engines, is 6 feet in length, with 100 flues, and can bear a pressure 200 pounds to the square inch. The driving wheels are 10 feet in diameter, and 26 inches on the face, each braced with two sets of iron spokes athwart each other. They are turned by means of a pinion connected with the main shaft or axle-tree, which works into an internal gearing of the size of the inside diameter of the wheels. On the outside pieces or ridges of iron are attached to prevent the wheels from slipping. There are two leading wheels, 5 feet in diameter, and 13 inches on the face. The weight of the whole machine is $7\frac{1}{2}$ tons, which is applied on the front of the driving wheels to produce a steady motion. Two men are required to work this engine, one to steer and the other to attend to the fire. Its working power is 150 pounds of steam, while it can be moved with only 15 or 20 pounds. Underneath the boiler is an iron tank and a fire-box. There is also a tender, which is used for carrying both wood and water.

"Frye's gang plow, another Detroit invention of considerable merit, is the only kind of plow which this machine has drawn yet. The shares of this plow are fixed on a triangular frame, which supports two gangs, and runs on three wheels. They are made expressly for the prairies, and will cut a wide or narrow furrow according to their arrangement on the frame. Mr. Waters states that the width of the cut, counting thirteen shares, is 19 feet, and that he can plow sixty acres a day."

At the trial at Chicago thirteen plows in three gangs were used, hitched one behind the other, which with the engine, tender, and water cart, made a train of thirty-seven feet in length. The machine, after showing its locomotive powers on the track, was put to its trial on the prairie, and made an astonishing start turning a breadth of furrows of nineteen feet at one operation, and running three hundred feet in two minutes, or at the rate of an acre in sixteen minutes, when the performance came to an end by the breaking of a wheel. It seems manifest that Mr. Waters's machinery is cumberous and expensive, and equally manifest that he failed at Chicago for want of care or skill in operating his implement, rather than in the principles of his plow.

An obvious objection to this machine is its great length, which renders it unfit for small fields, and the fact that it does not finish up its work, but leaves a strip of fifty feet in the middle to be finished by horse-power.

By the report of the committee at the Chicago exhibition it appears that two other substitutes for the plow were offered for examination, but no account of the performance of either has been published. One of these was offered by John Van Doren & Co., of Chicago, and is described as "a rotary cultivator, driven by steam and self-propelling. Beside plowing, it may be applied to other uses, such as harvesting grain, cutting grass, and, having a pulley of suitable dimensions, may be used as stationary power for farm machinery. This machine was at work at various times on the fair grounds, but when the committee sent official notice that they were ready to test it in detail the

owner could nowhere be found, and no opportunity was afterward afforded until the close of the exhibition."

The other, offered by B. F. Field, of Milwaukie, Wisconsin, say the committee, is "a revolving plow and seeding machine, and is thus made: There is an outer slatted drum of iron, $4\frac{1}{2}$ feet in diameter and 5 feet wide, made in three sections. Inside, on an eccentric shaft, are fixed three sets of 20 spades each, set 8 inches apart on 'spiders,' but all turning on one shaft. As they come in turn below, the spades project beyond the outer drum through the apertures, and the weight of the machine (2 tons) being thrown upon them, they enter the ground to the depth of 8 inches. The machine turning as it travels forward, the spades coming behind lift the earth as they emerge, and disturb its relative position as would a spade in the hands of a man, except that the soil is not inverted. Behind the spading apparatus, on the back part of the frame which surrounds the whole, is a row of ordinary drill sheaths to deposit the seed in the ground, which is fed to them by suitable hoppers with valves."

It is fair to conclude, from the facts thus brought together, that the subject of steam cultivation is attracting, both in England and America, the greatest attention. As yet, while we cannot admit that in either country any improvement has been tested, which so combines efficiency and economy as to give us assurance of its general adaptation, enough has been done to give us confidence that steam, especially on our broad prairies, must ere long render efficient aid to the farmer in tilling the soil.

CONSTRUCTION AND ARRANGEMENT OF HORSE STABLES.

(CONDENSED FROM DR. RUEFF, PROFESSOR AT HOHENHEIM, GERMANY.)

As most diseases of our domestic animals originate from the domestication to which they have been subjected, a condition often far removed from the natural one, it devolves as a principal duty upon the breeder and owner to take such care of them that this change of life, instead of an injurious, may have a beneficial result. Attention given to horses combines economical advantages, as feeding them in stables is not only a saving of fodder, but, under certain circumstances, also of labor.

The place where domestic animals are kept forms an essential consideration. In all countries, not sparsely settled, and therefore thoroughly cultivated, animals pass a great portion of the year, and even of every day, in the stable. This applies especially to horses, and easily explains the fact of more care and expense being bestowed on them than on any other domestic animals. Yet it is equally true that the labor and money expended for such stables are often insufficiently rewarded by the welfare of their occupants, because the construction

and arrangement are seldom executed with a degree of information corresponding to the importance of the matter, and for the special reason that the necessary knowledge of architecture and diet is rarely united in the builder.

In many cases, building a stable is left to the architect alone, who, when provided with ample means, is apt to indulge too much in his esthetic genius, often regardless of things appearing to be insignificant in themselves, though very important with respect to the principal object. Such things are often neglected, because of their being in contrast with his views of architectural beauty, and opposed to his plans. If, however, the means are limited, as generally happens, the building, notwithstanding the best wishes and knowledge, will often be erected in such a manner as will not answer even the most indispensable requirements.

On the other hand, the keeper of horses would not seem able of himself alone to arrange his buildings, as he has commonly no knowledge or experience in architecture. It would, therefore, always be best for the proprietor and the architect to exchange their ideas, and unite in carrying out such purposes. I have myself received numerous instructions from architects; had the experience of many years in keeping horses; examined plans of stables in various places and countries; and have been led by my position to a profound study of the diet; so that I entertain no fears of architects being dissatisfied at my undertaking to furnish some advice on the arrangement of stables. At the same time, I hope agriculturists and owners of horses will be pleased to receive such views as are based on my own experience.

In the first place, a stable should be protected from climatical influences, humidity, heat, cold, and winds. Again, it should afford security from all mechanical injuries, providing even for comfort, so that the animals, being left entirely undisturbed, may gather new strength for the performance of their services. Atmosphere, light, and heat, as the fundamental requirements of life, are entitled to the highest consideration in the arrangement of stables, and in their application they should be made capable of modification by man. The following points, individually, seem to deserve special attention.

Location.—In constructing a horse stable, the principal front should be to the west, so as not to be too much exposed either to the northern winds or the hot sun during the middle of the day. If, from want of room, any other locality must be selected, the stable should be protected from the above influences by the cultivation of trees, or shutters, blinds, &c. It would not be at all advantageous to locate a stable near a hill-side, or any other elevation, especially one consisting of a loose and porous soil, or, being of rock, if the layers should descend toward the stable, as, thus situated, the water will frequently find its way into the building; at any rate, the wall next the slope will be injured; and besides, such stables are, for the most part, humid and unhealthy. If such a position cannot be avoided, a trench should be dug around the stable at a distance of some four feet from the ground wall, the bottom of the trench to be always lower than the level of the stable floor; or a loam stamp may answer the purpose. These precautions are indispensable if a creek runs near, the surface of which is

always, or even for a time, higher than the bottom of the stable. Wherever the location is such that the droppings of the roof or other waters would cause a general wetness both of the ground and the bottom of the stable, drainage must be provided for.

Stables are often joined to other buildings; when to dwelling-houses, they have the advantage of being uniformly warmed. Though the warmth evaporating from horse stables during winter is agreeable, yet such a close proximity is not to be generally recommended, as the ceiling and windows of stables are not so constructed as to protect sufficiently the human inmates from ammoniacal vapors, and as the flies, always numerous in such situations, are very troublescme to man. Yet there should be an easy access from the dwelling-house to the stable, which would allow a convenient superintendence; for especially in rearing horses is the proverb applicable: "The eye of the master is worth as much as a sack of fodder." On farms, all kinds of draft animals are usually kept together in one stable, for the purpose of better overseeing them and of saving time in the distribution of labor. But there are many disadvantages in this practice, especially if the egress from the stable is one and the same for horses and draft oxen. Mutual injuries would result, and an undue cooling of the stables in winter, as oxen, on account of their slowness, require the doors to be kept open for a longer time. An additional reason will be found in the fact that horses require for their welfare a higher degree of temperature in the stable than oxen.

The ground.—The ground, on which the stable is to be erected, should be solid; especially avoiding peaty or marshy ground, otherwise the evaporations penetrating the flooring would fill the close rooms built above, and render the premises unhealthy. Loose ground absorbs too much urine, which, decomposing, will generate dangerous vapors of bad odor. In case of such improper foundation being unavoidable, solid stone pavements, tight gutters, spouts, and drains, must be provided.

External wall.—The inclosure is sometimes very imperfect. Stables on pastures are often without any walls, only a roof supported by columns being provided as a shelter from rain and the heat of the sun. If something better may be intended, these "sheltering huts" are merely closed with boards, and cribs and racks furnished for the purpose of feeding, if necessary. Nor is there much more solidity in stables constructed of hurdle-work. The mode of building of mud, or layers of stamped clay, has no claim to durability, as it affords no firm support for cribs and racks, which in horse stables require to be solid. Stables of beams and rafters, or the log-house structure, the interstices of which are filled with moss, will keep warm, yet, being perishable, they will not only be too expensive where timber is dear, but are also much exposed to the danger of fire.

I have seen a stable in the form of a log-house, with filled walls, which lasted thirty-one years. The pine logs, usually from three to four feet long, are inserted by means of tenons in the grooves of the perpendicular oak-columns and corner posts. To prevent the air from penetrating through the joinings, grooves are made, both on the upper and under side of the logs, and laths inserted in the grooves. The

logs employed are usually from six to seven inches in thickness. These wooden walls should be wainscoted, and as they are more liable to injury near the windows, they should be carefully protected there, by being covered with tin or painted with tar. Such buildings will be more durable if the roofs project to a great extent.

The best massive walls are those made of granite, limestone, and sandstone. The most suitable material for building stables is tufaceous limestone, resisting, in consequence of its porous quality, the rapid change of temperature, retaining firmly and for a long time its plastering, and being in many localities very cheap and easy of manufacture. In the majority of stable walls of stone, there is an essential evil, to be noticed in the generation of niter, in consequence of which not only the quality of the stone is impaired, but the stable is kept humid, on account of the hygroscopic qualities of the salt produced. The formation of niter is explained by the unavoidable decomposition of the excrement of animals, under the influence of humidity and warmth, promoted by the want of cleanliness, and the properties of the walls. Especially stones of a very porous nature, for instance, soft sandstones containing much clay, the yellow sandstone, porous limestone, limestone with organic remains, as shell lime in some localities, mortar and loam, containing kali, favor the generation of niter. Solid and polished limestones, as marble and granite, will not permit the formation of saltpeter, which is also prevented by smooth plastering. All varieties of stone, however, containing lime, kali, and magnesia, will, particularly when favorably influenced by the want of cleanliness, warmth and humidity, form saltpeter. But as this formation is confined to a certain distance from the surface of the ground and the wall, special regard must be had that the lower portions of the wall most exposed to humidity should be built of the best and densest material.

Ceilings.—Vaulted ceilings of brick or stone afford the greatest security against fire; they keep warm in winter and cool in summer; prevent the falling of filth from above, and permit no vapors to penetrate into the upper portion of the building; but on account of the side pressure caused by the vault, they require stronger walls, and are therefore expensive, both at the outset and in reparation. Besides, the vaults allow only imperfect ventilation. Wanting good and durable stones, the ceilings must be plastered, but on account of the different parts of the vaults not being uniformly warmed and moistened, such ceilings will soon crack and fall. Owing to this variation of temperature, vapors will collect on certain parts of the vault, and frequently fall in drops from the ceiling in winter, so that either some of the animals will be molested, or portions of the stable will always be damp and impure.

If it is intended to make a cheaper ceiling, it must yet be remembered that solidity is important, so that neither the dwellings that may be above the stables shall be molested by the vapors from below, nor that the beams and rafter shall thus be affected. If there is fodder stored away above the stables, it will also suffer from these vapors, and the filth, dust, and offal of hay falling through the ceiling will

render the skin of the horses impure, cause itching, and even in some cases, disease of the eyes.

Ceilings made with gypsum are unsuitable, as they will not last long; the wire and nails which support them rusting off, and allowing the material to drop, so that the animals will be dangerously excited, or even considerably injured. The advantages of plastered ceilings, in preventing vapors from penetrating, may also be secured by making them oblique, grooves being formed in the rafters, into which boards are obliquely inserted, so as to render them durable and easy of reparation. As better security against fire and the penetration of vapors, they may receive at the top a layer of mud mixed with gravel, or of loam with chopped straw. They will thus, also, retain a greater degree of warmth. The loam may be spread above to a height equal with the rafters, if the upper room is intended for storing away fodder; or there may be a common flooring, the space between which and the oblique ceiling to be filled with a non-conductor of heat, for instance: ashes, awns of barley and chaff. The filling up will keep warm, without being liable to catch fire, as many believe; for a fire may even be extinguished by means of chopped straw and chaff.

It should always be kept in view to prevent the beams of the ceilings from becoming rotten, a thing which so often happens. Some are of opinion that this object could be accomplished by shutting off the beams from the space of the stable by another ceiling, and thus protecting them. But it should be remembered that air and humidity are not so easy to be kept off, and that they will still penetrate through the joinings of the lower ceiling. The injurious consequences of these vapors will be more apparent when they are confined, as is indeed the case if the rafters are wainscoted both above and below. Should a current of air, however, be permitted to pass through, the ceiling would become too cold, and the vapors, precipitated too freely, would destroy the wainscoting. Were awns or chaffs, which would keep warm, put between, the air would still penetrate, thus moistening the beams; and in this case also, on account of insufficient change of air, they would be destroyed.

The worst method of constructing a ceiling is that of wainscoting by means of nails; it will soon be destroyed, the nails not being durable.

Others are of opinion that the beams could be better secured by leaving them perfectly free at the ceiling; they put on, therefore, a wainscoting above, or, for the sake of cheapness, small boards from one rafter to another, upon which they make a flooring of loam, or, still better, of gypsum. This kind of ceiling is very suitable when it is intended to keep fodder above the stable.

The stables should never be of such height as to prevent their being perfectly warmed. The destruction of the beams of the ceiling is merely caused by their becoming thoroughly moistened, a circumstance produced by too strong a cooling of the air saturated with vapors. Any stable in which the upper layers of atmosphere, being otherwise always the warmer, are rendered so cold that the watery vapors are precipitated, (in fluid form,) must, on the whole, be too cool. A

height of ten or eleven feet would seem to be most suitable where not more than six horses are kept.

The floor.—The part of the floor on which the horse stands may be constructed in a different manner from the passage-way. The former must be convenient for resting, and strong enough to bear the long-continued pressure of the body of the animal; it must also be so contrived as to prevent the accumulation of impurities.

As to the direction of the surface of this standing-place frequent mistakes are made. From over-care to secure the flowing off of the urine, the descent is often made too sloping, being five per cent., and even six per cent. Thus the horses are placed on a declivity, requiring a continual strain of the muscles of the limbs and back; the animals become tired in the stables, instead of resting; and their joints grow diseased, showing excrescences, barbels, defective positions, &c. Horses not shod, and colts, will, on a sloping floor, use to excess and wear away the front part of the hoof, while the proper standing parts are so little employed that they cannot sufficiently expand, thus becoming goat-hoofed and heel-bound, as indicated by too upright a position in the pasterns and fetlock, known as "goat-footed."

Whoever may observe horses in such situations, will find that, if possible, they choose an oblique direction, so as to gain a horizontal position for the length of their bodies. The care employed for the flowing off of the urine is, in most cases, not founded on perfect reason, because the males only would discharge their water within the stand, while the mares would wet the stand but little. Besides, with horses receiving no green fodder, this discharge is not so copious as to cause so much anxiety about drainage. At the same time, if there is always litter on hand, as it should be in a well-arranged stable, no water will flow from the stand.

A descent of the floor of from one to two per cent. is most suitable; horizontal stands not answering the system of the body of the horse, which is generally somewhat higher behind than in front; such construction, therefore, shoving the over-weight of the hind part toward the front or forepart of the animal. But in the passage-way a horizontal floor is the best, the objection being with regard to cleanliness; therefore, it may be a little arched, with a descent of from two to three per cent.

The material of the floor often consists merely of earth, or of loam beaten down; or it is a barn-floor, composed of loam mixed with iron scales and blood; again, a floor is made of gypsum, or four and a half parts of gravel with one of hydraulic lime.

There are, however, some floors unsuitable for stables. Loam mixed with sand, so often employed, is too liable to crumble. It would be better to use pure, uniform, and well-worked loam, which should be applied to a thickness of from 8 to 10 inches, and well beaten. A layer of hydraulic or black lime, two inches in height, on the moistened surface of the loam would contribute so much to the solidity of the floor that it would for a long time resist the tread of the horses.

Another good floor may be formed of seven parts of peat ashes, finely sieved, and one of slaked lime. Both substances are made with

water into a stiff dough, which is put on and stamped, either alone in a large quantity, or on a common loam floor in a more limited quantity.

As all these substances are slower in drying than gypsum, the surface requires to be frequently moistened in order to delay its drying until the inner layers shall have become perfectly united. In this manner the bursting and splitting of the mass may be obviated by repeated beating and stamping. If the materials for such floors are not well selected, or if the layer is too thin, they require frequent reparations, and are both expensive and troublesome.

They will not last long, in any situation; the action of the urine softens them, and they are loosened and broken by the shoes of the horses. They may only be applied in rather large running stables where young colts are kept, or, if at all in others, in the passage-way, where horses are neither too heavy, nor frequently brought in and out, and where there is great attention paid to cleanliness. Neither are those floors to be recommended for colt stables, where the colts are confined to one stand.

Macadamized floors, in inclosed spaces on which there is no driving of carriages, will never attain the same solidity and uniformity as is observed on open roads, and are, therefore, totally unfit for stables.

Common pavements are the most durable, and therefore the cheapest, the price, of course, depending not only on the locality, but also on the different kinds of stones to be used. Pavement, when used in the stand, has the disadvantage of more rapidly loosening and wearing out the horse shoes than on a floor made of wood. Some of the blocks, also, will inevitably sink, causing four-sided holes or pits, which are known to be dangerous. A pavement neglected and out of order will produce an unequal pressure, contusions of the body of the horse occupying the stand, &c.

For the same reason, those pavements made of rolling stones, and which so many see fit to recommend, should never be employed. It was thought that the sliding of the horses, so common in paved stands, could be prevented by employing stones not larger than a fist, but it is precisely on such, well-rounded and highly-arched as they are, that the foot is most liable to slide. Moreover, a great deal of dirt collects in the numerous deepenings and gutters between the stones. To a great extent the sliding may be obviated by allowing the floor in the stand but a very small descent, as above intimated, and by employing a material not too hard or rough; for instance, mixed sandstone. Granite would be better than shell-lime, Lias-lime, or Jura-lime, though sandstone wears off the horse shoes more rapidly than any other variety of stones.

The best pavement both for the stand and passage-way is made of double-burned bricks, which, after being closely laid with the high edge on a flat stratum of similar stones, are fastened with cement. All stone floors are, besides, liable to the objection of being a cold place of rest for the animals, and of subjecting them, under certain circumstances, to catching colds, a fact which will not so often occur on a wooden floor, that being a non-conductor of heat. If horses are obliged to rest on an uncovered floor, either standing or lying, their tired muscles and irritated feet will certainly sooner and better be re-

lieved on a soft wooden floor than on a hard pavement. The disadvantages mentioned, however, in regard to the stone pavement may be removed, or at least modified, by a good litter, so that a stone floor may safely be recommended to all farmers provided with a sufficient supply of straw.

Wooden pavements are not at all suitable for floors in the stand, as the blocks, being often different in age and solidity, wear out unevenly, leaving pits, as in the stone pavements above mentioned. This material also readily absorbs the urine, which decomposes, producing bad odors in the stable and decay in the wood itself. It is generally suitable only where carefully kept dry, and may well be applied in the passage-way, for on such a pavement the tread of the horses is secure and pleasant to them; nor does it wear their shoes. The stratum below the wooden blocks ought to be porous, consisting, if possible, of sand, so that the liquids accidentally leaking through the joinings shall not collect below the wood; as a preventive, fine sand is sometimes swept and strewn into the joinings. The blocks should be from seven and a half to ten inches in height. In some large stables, this wooden pavement in the passage-way lasted over twenty-one years, without requiring any essential repairs.

Where, from the greater value of horses, it is the desire to arrange everything in the best way with regard to the health, strength, and even comfort, of the occupants of the stables, and where there is no scrupulous regard to expense, the floor of the stand is made of boards.

These stands may be constructed in different ways. The simplest method is to lay the boards directly on the sand or the natural ground. Another method consists in first laying down a floor of stone, bricks, or asphalt, which may conduct the liquids leaking from the wooden floor into the principal channel, either by a deepening on the lower surface, or by one or two gutters. On this water-tight floor, and in the direction of the length of the stand, three oaken beams are laid, upon which the boards are finally placed, so as to give them a secure foundation. All these board stands are somewhat expensive, as they require freqent repairs. It has been asked, which of the two methods is the most durable, or the best? To the hollow floors it is objected that they are dangerous to horses, whose hoofs might easier be caught in the holes often caused by the blocks decaying through, producing distortions of the limbs; or, it is feared the horse will stamp through the worn-out boards, and fracture his bones.

This stamping is not so dangerous as some may believe, for an attentive keeper will, from time to time, remove the defective boards; neither will an intelligent builder construct the drains on the lower floor of so great a descent that the foot would be injured by descending in them. Two gutters made lengthwise, or a single flat gutter, would be sufficient to carry off the urine leaking through the board stand. Their descent need not exceed from five to six per cent., while that of the board floor should be one to two per cent.; the hollow space below thus being but three inches at the deepest spot, provided the floor has not been unnecessarily raised by the beams. If there is a double gutter on the lower floor, the beams may be dispensed with, by construct-

ing the edges of the gutters and the backs between both gutters in so accurate a manner that the boards can be laid down flat and solid.

Some are of the opinion that boards laid down hollow are sooner liable to rot and to be destroyed, if they only become wet from below, and therefore they prefer laying them immediately on the ground; thus the whole board is always kept wet on all sides, as the water is continually coming up through the joinings. It is said that the wood is thus just as well preserved as if it were totally kept under water. But experience shows that the boards are less injured by decay than by shoes, hoofs, and sometimes even by the teeth of the horses. The hollow floors are always clean and dry, while boards laid directly on the ground are wet and dirty, spattering the hoofs, and often the legs, with manure water, which is the cause of rottenness of the frog and malanders. A board laid hollow, on an average, will keep for three years, so that the stand may still be said to be in good condition.

In laying these boards, provision should be made that they may easily be taken up again, either for changing or cleaning them. In changing them, the boards occupying the forepart of the stand, and not having been injured so much, may be substituted for those forming the back part, which are therefore more worn. They may be cleaned by taking up the front board and washing out the slab-floor below, pouring a bucketful of water through the opening made by the removal of the first board. This operation should take place every eight days. All the boards, however, should be taken up once every three months, so that the slab-floor and gutters may be thoroughly cleansed with broom and water.

Those boards lying immediately on the ground, being always wet, become softened, and are therefore apt to wear out faster by the feet of the horses than dry wood of the same quality. It seems to be improbable that wood continually saturated with and buried in manure water should be less liable to rot than wood accessible to air, and therefore, for the most part, in a dry condition. To facilitate the flow of urine through the boards, holes are made in them. This method, however, is unnecessary, and tends to accelerate the decay of the boards. The urine will find a way of itself through the joinings. The prominent part of the shoes of horses are sometimes caught in such holes, and thereby loosened; besides, perforated wood is more apt to absorb manure water.

In English stables, plates of cast-iron, perforated in the shape of a T, are sometimes used for the back part of the board floor to facilitate the flow of urine. Cast-iron floors will probably come into general use in stalls, because they are easy of removal and never entirely loose their value, as in the case with wood and stone.

As boards, when kept dry, are durable, they may be used for the floor of the forepart of the stall, and, closely joined, also for the back portion. With regard to the proper material, oak is the best, but the most costly. Beside, horses are more liable to slip on it than they would be on soft kinds of wood. If, however, but narrow boards are employed, or if four-cornered beams are laid across the ribs, so as to be changed four times, or whenever their surfaces may be worn out, the horses will not so often slip, on account of the many joinings.

Red fir resists moisture longer than white pine. Healthy and dry wood, which has not been cut during the running of the sap, (an important consideration in the building of stables,) should be procured.

From the preceding, it would seem that board floors are most suitable for light horses, whose weight will not produce much injury, and especially for mares, wetting at most the two last boards. In addition to this, it is thought that the use of horse shoes without points, as they are employed in Italy, France, and England, is especially favorable to the preservation of a wooden flooring.

In order to check the decay of wood in damp stables, it may be soaked before use in a solution of sublimate of mercury or kyanizing. This method, however, is expensive. Beside, attention may be called to the process patented by Bernett, consisting of muriate of zinc dissolved by iron vitriol and in water, in the proportion of one to six. Particular attention is called to the method proposed by Münzing, of soaking in sulphate of manganese. In consequence of the application of these saline liquors, the albumen of the wood, by which decay is principally generated, is made to coagulate, so that decomposition, as is the case in smoked meat, is very much delayed, if not altogether prevented.

In some studs, the floors of the stalls are made of asphalt. Though these appear to be very clean, yet there are many disadvantages conconnected with them. Horses will crumble the material in a short time with their shoes, making its repair difficult, as special mechanics would be required. Horses not shod are liable to slip on this kind of floor, notwithstanding it may have been provided with notches. Yet, where not too costly, it may be recommended for stables of cattle.

It may be here mentioned that in England some stables have the floors of their stalls made of gutta percha and caoutchouc. This appears to be a luxurious experiment, no doubt agreeable and beneficial to the horses, but not easy to introduce generally.

Finally, the arrangement of stable floors deserves our full attention, as the expense of the building itself, the health of the animals, and cleanliness, are intimately connected with it.

Accommodation.—The space of a stable ought to be in proportion to the number of horses. The room required for horses of every size is nearly the same; it would be unreasonable to take a small race as a basis for the capacity of a stable, even if small animals were usually kept.

A single stand should be six feet wide and eleven long, being sixty-six square feet. Horses measuring from seventeen to eighteen hands are rare, and require a width of seven feet, while those measuring from twelve to fifteen may be content with five feet. If the stands are too narrow, there will be no convenience for cleaning or giving food, the animals cannot rest themselves, and wear out the narrow floor much sooner than they would a broad one. If the stall, however, be too broad, the horse will often place himself crosswise in his stand, be more apt to strike into the chains, and will find more occasion for kicking against the horses in his neighborhood.

Should there be but one row of stands in a stable, the width of the passage should be at least from six to seven feet, so as to allow the

horses to turn themselves in it without receiving any injury; but, unfortunately, the space assigned for this purpose is too frequently only found to contain but from three to five feet, so that men and animals entering here are exposed to the danger of being kicked by the horses occupying their stands. If the passage should lead between two rows of stands, so that the back parts of the horses are opposed to each other, it should be at least from nine to twelve feet wide. If they are placed with their heads opposite each other, it would be sufficient to have a fodder passage three feet wide between the two rows of stands, though a width of from five to six feet would be better. Such an arrangement would not only save time, but also afford security in feeding; it is also thought that the horses, in consequence of the lively intercourse going on in front of them, would become less liable to taking fright.

The height of a stable should be in proportion to the number of horses intended to be kept. The lowest height admissible is ten feet. It is true, there are some so low that the horses touch the ceiling with their heads. This is a cruelty, and brings its own punishment by the impaired health of the animals. The upper atmosphere in a closed room is always the warmest, and, at the same time, the most impure; while the floor, with its pavement and humidity, cooled through the openings of the gutters and the draught of cold air from the door, will be productive of cold feet. Thus, it is not to be wondered at that the blood should rise to the head, and diseases of the brain and eyes be produced in those stables; for the proverb, originally designed for man, is equally applicable to our domestic animals:

> "Would you be well, and would you grow old?
> Keep your feet warm and keep your head cold."

For two horses of middle size the height of a stable should be eleven feet; for a larger number, say from three to eight heads, twelve to thirteen feet would be sufficient. But where there is a very large number, as in cavalry stables, stud establishments, &c., it would be advantageous to increase the height to from sixteen to twenty feet. A more lofty ceiling might be considered a luxury, but a rather inconvenient one, as it would hardly be equally warmed in winter, so that dampness in some parts could not be prevented, or ventilation must be avoided in order to retain sufficient heat. Many agricultural stables admit of fodder-wagons being driven into the passage, in which case the height must be greater than would seem to be advantageous for a proper temperature.

If the size of a stable be not in proportion to the number of animals kept, the stands not occupied should be filled out with straw, &c., and if the horses are not sufficient to produce the warmth required in winter, the ceiling should be brought lower down, by extending poles, rails, or bars, and filling the intermediate space with straw. No such straw should afterward be used for any other purpose than litter.

Division of Stalls.—To avoid frequent troubles and even heavy losses of animals, each horse should have his separate stall; for even the best-natured will at times make use of his natural weapons, and usually peaceful neighbors will fight each other in the most violent manner,

so that their lives or limbs are frequently risked. This division is especially necessary with regard to those horses of an irritable, envious, and mettlesome disposition. Mares seem to require particular attention in the breeding season, though they are, at other times, exemplary, quiet, and peaceful.

The most simple separation of stands is made by inserting poles, with one end between the rundles of the rack and the other fastened to the floor. This is but a very imperfect contrivance, yet it must be admitted that horses usually show respect for such a line of demarcation, notwithstanding the lowly laid pole at the end does not prevent them from kicking. It seems that they are afraid of getting the pole between their feet, or that there is not so much cause for kicking, as the two neighbors cannot so easily touch each other. The poles, however, may, according to their application, answer more or less the object contemplated. There is an essential advantage in raising the lower end of the poles a few feet above the ground, so that the horse, when kicking, should strike the barrier instead of his neighbor. This location of the poles may be effected in different ways. In stables where there are no posts, at least no stand-posts right and left at the end of the stands, they are suspended by traces or chains fastened either to the ceiling or the rafter, and the forepart placed either in rings in front or at the side of the crib, or secured by means of small chains or hooks. These hanging poles can readily and cheaply be put up in every locality, and have the advantage of allowing horses more room; besides, no stand-posts being required, the tails of the animals are not liable to injury by rubbing. Still the room thus afforded is too ample, and the horses, by swinging the poles, voluntarily or not, come into contact, which often incites them to kick.

It is always better to fasten the poles to the posts in the rear of the stand, so as to allow but a limited side-movement; the poles should be capable of being easily raised, for it will frequently occur that the horse will roll himself under the poles, and, in suddenly jumping up, will strike against them, falling crosswise on his back, frequently causing dangerous injuries; for instance, laceration of the spinal marrow, &c. This being generally known, dividing or separating poles fastened into the stand-posts are rarely found, or in those short stands only where the horses are prevented by the post from rolling themselves into the stand adjoining.

There are several contrivances for hanging the poles, the simplest of which is the following. A groove is made in the stand-post, in which groove the separating pole is shoved down to within three and a half or four feet of the ground, and moved upward to a height of six feet. To prevent the pole from falling out after it has been raised beyond the length of the groove, a rope is drawn through the tenon of the pole. This rope is fastened to the stand-post at both the upper and lower end of the groove, so that the pole is held by the rope in a proper position in case the tenon should be moved beyond the groove.

Another and well-known arrangement consists in the long iron hook, turning itself by means of an enarthrosis at the point of its insertion into the stand-post. This movable hook is held in an upright position by a ring fastened at some higher point of the post. If the horse

happens to lie under the separating pole, the ring, by being shoved up, detaches itself from the hook so as to hang out the pole. The movable hook is principally intended for hanging the pole with ease, in case the horse has struck across the pole and rides on it; in this case the ring is shoved off the hook, and the latter turned downward, letting the pole and the horse down to the floor. (See figure 1, plate 2.)

As the mere poles would afford but insufficient protection from kicking, walls of various kinds are suspended from these poles. The simplest and cheapest are straw-mattings. Long rye-straw, somewhat wet, is turned round the pole, and the lower ends twisted by means of three rows of packing-thread, to a thickness of from four to six inches. These partitions have the advantage of not causing any contusions, but by being frequently kicked at they will soon be torn in pieces, so that they will not answer for unquiet horses. This straw wall is only fastened to the hind part of the pole, because it would be too soon spoiled by gnawing if hung up at the forepart.

More durable are the wooden walls suspended from the poles, consisting either of a contiguous board, or of several boards joined. They must be provided with ledges, or made double, else they will burst after the first kicks from a powerful horse. They are suspended from the poles by means of leather straps or ropes, but iron bands are decidedly preferable; the nails, however, must be carefully driven in, and their condition always receive attention.

These movable partitions afford the advantage of comfortably lying down; the horses may turn round without receiving injury, and, when kicking, the effects and scratchings will be less violent; yet, after several years observations and experience, I must pronounce against movable partitions, as the danger of horses harming each other, when engaged in violent combats, is greater than in stalls with immovable partitions, beside the movability is frequently the principal cause for such combats.

Comparing both the advantages and disadvantages of movable with immovable partitions, the latter seem to deserve the preference. Though generally known and in use, they are rarely so arranged as to answer the purpose. Most of the fixed partitions are too low, so that the horses may strike beyond them, which is the more dangerous as the partitions cannot readily be removed. The wall near the crib is usually from four to five feet high; toward the end from three to four feet, and consequently there is a descent. This arrangement is explained by the fact that the horses present a more stately appearance in a stall low at the back part; the height in front corresponds with that of the crib. This structure is certainly irrational, as the protection and insurmountable separation in the rear is of more importance than near the crib. It would be better to have a partition-wall of at least four feet, and of equal height throughout the length of the stall. A grooved sill is laid on the ground, with its tenons immediately inserted in the wall, or in a wooden crib-post in front, and into the stand-post in the rear. Above there is a strong pole, likewise grooved, inserted both in front and rear, to correspond with the sill. Then, there are boards from one and a fourth to two inches in thickness, perpendicularly inserted into the grooves of both the upper pole and the

sill. The boards should be rather strong, so that repairs, which otherwise would frequently become necessary, may be saved. By giving the partition an uniform height, an essential advantage is gained with regard to expense, for we are enabled to change the position of the boards, and such of them as may have been split by kicking can be transferred to the front. Injured boards may easily be replaced by keeping some of the same length on hand. By means of a wedge the grooved pole is mortised into the stand-post, so that it can be taken out for changing the boards. To insert the boards lengthwise, running parallel with the grooved pole, as is done sometimes, is not advantageous, because long wood is more liable to split, and is usually exposed to the full force of both feet, besides, repairs are more expensive, as the boards to be inserted would require some eight or ten feet in length.

The walls of the stalls are sometimes made by wainscoting both sides of the grooved pole down to the sill, so as to join the side of the pole to the board-wall; but nailing the boards is always more dangerous than to shove them in the grooves. If boards are used for this arrangement, the double-walls will become too expensive; and if light planks are used, they will soon be demolished; besides, the hollow space between the two wainscotings will serve as a retreat for rats and mice.

Most contentions being caused by envy of fodder or mutual vexations of the animals, care is usually taken to keep their heads also separate. In general it is deemed sufficient to prevent the horses stretching into the adjoining stands, so that they may not bite each other, and steal their fodder; studs, however, of an especially irritable nature, will, particularly in the breeding season, by the mere snuffling of a neighbor, be incited to the most violent kicks. The top partition walls opposite the fore part of the horse should therefore be constructed in accordance with the necessary requirements. These tops, or "swan-necks," may be either solid, or of slat-work, the latter being sufficient in most cases, and having the advantage of not darkening the stands too much. To answer its purpose, a "swan-neck" should extend one third the length of the grooved dividing pole, and half the height of the rack. These portions being very liable to be gnawed when made of wood, ought to be covered with iron. As, however, slat-work thus protected is expensive, and as even hard wood is easily destroyed by some horses, tops of cast-iron, without ornament, are strongly recommended. (Figure 2, plate 2.)

Figures 2 and 3 are drawings of tops, cast at the Royal Foundry at Wasseralfingen, Wirtemberg. Figure 2, weighing about forty-two, and figure 3, thirty-eight pounds, and costing three-and-a-half cents a pound.

The slats being brittle and fragile, horses should never be fastened to them. If any part of this division should happen to break it should be immediately repaired, as the sharp corners and sides left by the fracture are frequently the cause of dangerous injuries. "Swan-necks" may be fastened by inserting them in a groove of the pole and

in the wall and screwing them, so that in case of repairs becoming necessary, they can easily be removed.

If there are two posts at the rear of the stand, they should be constructed with regard to the welfare of the horse, and not exclusively to please the *esthetic* taste of the architect, as is often the case in stables otherwise arranged with the greatest luxury. The cast-iron posts are often provided with octagonal pedestals, adorned with various high reliefs, against which unquiet horses, even when not engaged with their neighbors, will, during the operation of cleansing, strike their feet and hurt themselves. These posts should always be round throughout their entire length, or, at the least, the corners should be rounded, that the beauty of the tail may not suffer by being frequently rubbed against them. To guard against such rubbing, either a piece of sole leather, with inverted nails three-fourths of an inch long, or the skin of a hedge-hog, should be appropriately fastened on the post; or the horse may be kept off by fixing a bar at each of the grooved poles, within the last two-thirds, the bars at the commencement being firmly fixed to the poles, while in the rear there is a distance of half a foot between the post and the bars of each side, the two bars converging from front to rear, thus narrowing the stand somewhat in the rear, without being an obstacle to lying down. This at the same time renders it impossible for the horse to touch the post.

Again: The tail of the horse is often deformed, in consequence of all parts of the stand not being even and smooth. In trying to keep off the flies, single hairs are easily caught by detached woody fibres, or by some joint of a chain, and so torn off. The posts and other attachments may therefore be covered with paper, or heavily oiled, thus preserving the tail from injury when it is frequently swung in summer. Planed columns of oak wood might serve the same purpose. Soft wood is liable to splinter, and the lower parts soon became rough and deformed by being kicked against. In England there are many stables with cast-iron posts.

Where valuable horses are kept, but of an irritable nature, frequently kicking when being cleaned, the walls of the stands and posts should be provided with cushions or straw mattings. In the stall itself there should be no projecting nail, nor even the head of one. All arrangements requiring many nails, for instance, tin coverings, should, if possible, be avoided. Whoever may be unable to furnish his stable with stone and iron, should try to protect the wood from being gnawed by painting it with tar, or giving it a coat of bitter substances, such as the decoction of wormwood, nut-shells, &c. The best protection consists in covering walls and wood with cast-iron or delf-ware; this mode, however, being expensive, tin covering is frequently resorted to. Zinc is preferred to iron plate, on account of oxydizing less rapidly. It seems to have a disagreeable taste for the tongue of the horse, for most of them are fond of licking the rusty iron, while they will rarely touch the zinc. An additional advantage is, it is capable of a closer application to the wood than iron, which is always molting and drawing the nails out of the wood, causing their heads to project so as to frequently injure the skins, eyes, &c., of the horses. For the same reason, straps with buckles should be avoided in fastening the

"kicking boards" to the dividing pole, and every hinge about the stand should be well rounded.

By extending all posts to the ceiling, the floor above the stable, as well as the building generally, will receive a stronger support. Free standing posts, unconnected with the ceiling or the rafters, are deficient in firmness, even if they are inserted in the ground to a great depth; by being kicked and pressed against, they soon become loose. There is still more danger in having very low posts, over which the horse when kicking may even jump. The lowest admissible are five feet, being at the same time adequate to all partition stand-walls, though a too low division is far less objectionable than a post too low, which, in case a horse should happen to hang upon it, will cause contusions dangerous to the life of the animal. A foundation of stone for the posts would protect them from decay.

Doors.—The number of doors should correspond to the size of the stable. Though it is not necessary to pay the same scrupulous regard to the danger of fire in horse stables as must be done in those for cattle and sheep, as these animals can only with the greatest trouble be driven out from a building on fire, yet it is always advantageous to give a stable several chances of egress; it will not be required that all should be opened and used for everyday purposes.

The door most in use should be on the side toward the sun, so as to prevent, on its being opened, much cold air from rushing in, and that the horses, on going out, shall not be made to feel uncomfortable by the change of temperature.

If two doors are needed in a stable, they should be opposite each other, as the circulation of fresh air is thereby favored, without a draft touching the animals, the space between both doors usually forming the passage. It is best to place the doors at the narrow gable-end, because this would facilitate the superintendence of the whole stable. At the same time, there is not so much pressing of the animals in going out as there would be at a door in the middle of the building.

The door should be ten feet high, if possible, so as to allow a horseman to ride without injury into the stable, and the width at least six feet, so that two horses may pass at once, and that harness and saddle shall not be damaged.

The height referred to is also favorable to the circulation of air above. It is altogether objectionable to provide the doors with prominent sills, as these give frequent occasion for stumbling, dislocations, &c.

The door-posts should be round, or, at least, their edges. Stables for colts, which are in the habit of pressing with haste and force through the doors, should always be provided with movable cylinders, fixed outside or inside of the edges, or, still better, to the inner side of the door-posts. This method will prevent injury to the hips, when the colts are driven in or out. To be really serviceable, cylinders should be at least six inches in diameter, and six feet in height. The precaution contemplated is often lost, on account of the axle getting rusty, thus preventing the movement. This obstacle must be avoided by affording ample room to the axle and the ring, and by frequent greasing.

The door should be provided with two wings, for a single door of the requisite width would be too heavy, and, being often opened for the passage of men, would not allow the stable to retain sufficient warmth during winter. If both wings were from five to six feet wide, one of two feet and a half or three feet would afford space for a convenient passage. Doors from eight to nine feet in height and four in width may answer for small stables.

A chain secured across the door-way at the height of four feet would keep those horses which may have become unfastened from going out, if the doors were opened in summer for the purpose of ventilation. If intended to keep them open during warm nights, the chain must be capable of being locked, so as to guard against thieves. Half-doors, or those divided in the middle of their height, would answer the same purpose. Doors and wings should always open outward, as most horses, and particularly colts, would press in that direction. There should be no self-closing doors; for if they are not made to stand immovable on their hinges, they will produce frequent injuries to animals and harness, on their passage. A practical arrangement for retaining the warmth of the stable consists in putting up inner doors, or lining the outer ones with leather, bands of twisted straw, or cotton, or boards of cork.

Preferable, however, and in addition to the common door, would be a closed space in front, serving at the same time as a room for harness, saddles, &c., and for cleansing purposes. This space may be either under the same roof with the stable, or otherwise.

A great advantage would thus be gained in not permitting the external cold to touch the horses immediately on the door proper being opened.

Special regard should be paid to the manner of locking both the outer doors and those of the various divisions of the stable. All projections, such as long latches, hooks, knobs, &c., are traps for harness and other articles, and should be avoided. The lock itself should be sunk in the wood-work. Whenever the doors are locked from the outside, an ordinary bolt is usually sufficient; but, to prevent the consequences of insecurity, the bolts within should be so constructed as to close themselves; which may be readily accomplished by making them of heavy iron, and, instead of a horizontal, giving an oblique position, when their own weight will fasten them. A bolt in reach of the horses must be provided with a stay-spring.

The space in front of the stable-door should always be level, without holes or obstructions, because most horses, in the act of going out, are awkward, stumbling, or wild, and therefore apt to make a misstep and fall. In the same place, and perhaps on the building itself, rings should be fastened for tying the horses, to cleanse them in the open air, when the weather is fine.

Stable-windows.—Light, one of the most essential incentives of life, promotes especially those animal operations, sensation and movement; while its absence favors the vegetative part, nourishment and the increase of fat. Light stables render their inmates always lively, and capable of easily receiving impressions; while dark ones deaden the nerves and produce laziness and unwieldy increase of fat. Aside

from these effects on the general organism, a glaring light irritates the eye, which becomes diseased if long subjected to its influence. The continued absence of light, or too much darkness, will deaden the optic nerve and make it insusceptible. Finally, it has been proved by experience that a sudden transition from inactivity to great activity can rarely be sustained without injury to the organ.

These few principles must regulate the construction of stables, and especially the arrangement of their windows.

Requiring of horses particularly the development of the animal part, or power of rapid movement, we find the production of fat unfavorable, and even directly opposed to it, and therefore must provide much light in stables. The eye being so important in the service required, we must maintain the health and activity of the horse by modifying the impressions of light. In this respect a stable should be as well supplied as the dwelling of man, thus favoring general order and facilitating cleansing and control. As horses are for the most part fastened to their stands, and sometimes unable to avoid the effects of the sunlight on the visual organ, the windows must be so arranged as not to incommode the animals.

The windows not only serve to convey light, but also air into the stable. It is, however, known that currents of air may, under certain circumstances, have an injurious effect on health. In accordance with this the following rules may be laid down with regard to the arrangement of windows. These should not be in front, but in the rear of the animals; if there is but one row of stands in the stable, this rule is usually observed. If it should, however, be necessary to put up a window in front of the horses, it should be placed at such a height as to allow the rays of light and the currents of air to pass above their heads. When the building does not admit of giving the windows the position referred to, the panes next to the eye of the horse should be ground glass, or common glass may be thus prepared by simply rubbing it with emory or fine sand, or painting it with lime. Panes of a blue tint would be still better, modifying to a great extent the effects of the rays of light on the eye.

Reflections from a bright surface being almost as irritating as the direct sun-beams, the walls of the stable should not be white, but a pleasant color should be produced, by the addition of either yellow or green ochre or pine soot. This should be done especially with walls fronting the heads of the horses.

For new stables a skylight is recommended, as it also favors the circulation of air. Side windows may then be omitted, or constructed on a very small scale. If it is intended to procure sufficient light from the sides, the stables will either become too high or the windows will carry the light directly to the eyes. Stables, therefore, amply lighted from the sides, and yet not injurious, are rarely found.

In case the windows are so low as to be reached by the head of the horse the panes must be secured by wire-work, or a similar contrivance, against being broken.

The material for window frames deserves special attention, as no part of the stable is so much exposed to moisture, and, therefore, to decay. At these places the cold and warm layers of air meet together,

producing drops of water. This dampness not only destroys the wood, but changes its form, causing either, directly, the glass to spring, or, indirectly, the breaking of the panes in opening or shutting, on account of the sash being too tight.

Material not so liable to injury from dampness should therefore be chosen for window frames. Oak wood is for the most part employed; wood of the red fir is almost as good, though it is more apt to swell than the oak, yet it will longer resist moisture. It would be worth while to paint the wood about the windows with oil color, to diminish the evils referred to. Cast-iron frames are decidedly preferable to wooden ones, as the expense for repairs would be greatly lessened. Tar putty is coming into general use for securing the panes. To facilitate the replacing of the windows, after cleaning them, it would be advisable to make the hinges of unequal length. The same should be observed with doors. In stables, where there are sensitive and irritable horses, fly-windows (being the first of double windows, and covered with a texture of fine wire) and curtains should be applied, so as to modify the light. To prevent the windows from freezing up salt should be applied to the frames, as salt water will only freeze at a very low temperature, which is rarely the case in stables.

Drains.—Drains for the urine of horses and other liquids occasionally discharged are made in all stables; for, if the removal of these liquids were left to natural evaporation, the atmosphere would always be surcharged with humidity, injurious to health; it would under certain circumstances become too cool; and decomposition, with its consequences, bad odor, and gaseous air, dangerous to lungs and eyes, would be produced, if those liquids were allowed to remain for some time in the stable.

Though, in stables which are kept clean and always provided with litter, no urine is seen flowing off for months through the existing drains, yet drains should not be omitted, as they may be needed for certain emergencies, as in a new method of feeding, for instance, large quantities of green fodder.

There are usually open gutters made of paving-stones; they should not be so near to the stand as to catch the hind-hoofs of the horse, in case he should back off from the crib, and should be flat, so as not to cause the animal to make missteps in going or returning. Where there are hollow stand-floors the principal gutters in the rear of the stands should be sunken, and therefore covered. In such cases they are, for the most part, made of stones, cut in the shape of gutters, with a groove above to receive the covering board. These gutter-covers are generally provided with holes so as to allow the liquids to escape, and are sometimes made of cast-iron, rough on the top.

Open drains are usually preferable, because they admit of being easier and oftener cleansed. They are recommended for all stables where the stands are paved, and require no particular expense, as they can be made in the first arrangement of the pavement. If the gutters are covered, they must have considerable descent, so as to cause the liquid to flow off of its own accord. If open the descent cannot be so great, because the gutter would become too deep in the rear of the last stands of the row. The operation of but a slight descent in open gutters could be easily assisted by the application of a broom.

The gutters should discharge their contents beyond the stable into the dung place or into a special basin of dung water, not situated in the immediate vicinity, but a few rods distant. The neighborhood of the dung place increases the bad odor and insects, especially flies. Where the gutter penetrates the wall of a stable, the opening is frequently too large, always admitting a draft on the animals standing near. Its size need not be more than that of the gutter itself. To exclude rats and mice, an iron grate is usually applied. It would be cheaper, however, to widen the sole of the gutter one foot, and deepen it five inches, either inside or outside of the wall, and insert a small plank, so as to bring its lower edge about one inch below the level of the sole of the rest of the gutter. The space immediately under the edge of the little board will be constantly filled with liquid, preventing vermin from entering, and still allowing the water to run off; this arrangement will also shield from drafts. Instead of this regulator, an iron grate may be used, extending to the bottom of the deepening, so that their passage would still be prevented, in case of a deficiency of water in the sink. The water will thus never be checked, as the mud frequently collecting will settle below, the grate being always kept open above. Grates applied at the end of a gutter of equal level are liable to obstruction.

Ventilation.—Without air there is no life, or, more properly speaking, no health without pure air. I will not now attempt to discuss the constituent parts of atmospheric air, presuming them to be generally known. Its consumption, however, by a horse is less known. The lungs of a middle-sized horse draw, at one inhalation, some one hundred and twenty cubic inches. In a normal process of breathing he will consume seventy-two thousand cubic inches per hour, and one thousand seven hundred and twenty-eight cubic feet per day.

The principal object of the consumption of this air is, by means of its oxygen, to bring the carbon of the blood into combustion, thus maintaining the necessary heat. The animal receives this carbon through its food. It may be assumed that a horse acquires about nine pounds of carbon per day, which is brought into combustion by respiration. This operation requires about two hundred and eighty-eight cubic feet of oxygen, forming but the fifth part of the atmospheric air, so that one thousand four hundred and forty cubic feet of atmospheric air are requisite for the process of combustion going on within the body. The product of this is carbonic acid, which, as is well known, is an irrespirable gas, producing by itself sudden death, and making the air, even when mixed in a small proportion, say from six to eight per cent., altogether unfit for respiration by animals.

Accordingly, a horse, kept in a space fifteen feet long, ten high, and twelve wide, the usual dimensions of a stable for two horses, would perish within a few hours, if the space were hermetically closed. Fortunately, there are no buildings thus sealed. If, through the process of respiration, by which carbonic acid and watery vapor are produced a surplus of carbonic acid beyond the normal proportion (1.2500) should be created, Nature herself, by her own accord, provides a proportion of mixture still suitable for the use of the animals, by making the various gases continually penetrate each other. Thus, an equalization of all the different atmospheric strata is effected, which is further favored and

accelerated by the motion of air, drafts, &c. This natural tendency of the various kinds and strata of air to mix with each other, has a more powerful effect than all ventilators, fans, or bellows.

The more inert watery vapors, and some kinds of gas originating from the decomposition of the excrements, are more liable to become stagnant, and will, even if they do not directly menace the life of the animal, still be productive of disturbances in some organic functions, and thus be detrimental to health.

The products of this decomposition, for instance, carbonate of ammonia and sulphuretted hydrogen, will particularly show their effects where manure is purposely suffered to remain for weeks, especially in winter, in order to use the heat, generated by the decomposition, for warming stables, and to prevent cold air from rushing in on the removal of the manure. But these kinds of gases, far from sustaining the process of respiration, will, by their caustic properties, affect the animals, irritating the pituitary membranes, nose and eyes. If from the equalization referred to above, special contrivances for the circulation and purification of air should not be ranked among the indispensable wants of a stable, yet they would favor the preservation of health, the comforts and development of power of the occupants.

There has long been a desire, therefore, and several efforts have been made, to provide stables with effective ventilation. Most of these methods evince, at least, good intention, but too openly betray a want of knowledge of the respective laws of Nature. I will now briefly notice some of the most familiar methods of ventilation.

Thus, openings made in the floor, if corresponding openings be not made above, or at the opposite wall, will have no effect, or if any, the draft will generally injure the animals.

Drafts immediately below the ceiling are not altogether objectionable, as they allow the air to pass out from the upper strata; if they are not too wide, the atmosphere carried out will not be supplied through the same opening, so that no cold current will descend upon the animals standing near, the air being supplied through the numerous cracks and pores of the building, thus not causing too great a draft. If the openings are somewhat wide, they should not be in the neighborhood of the horses. A simple opening like this will, however, then cause only a brisk circulation of air, if the difference between the heat of the stable and that outside is a very considerable one; if the temperature both out and in is equal, an imperfect purification of air will be produced. In these cases the restoration of air, could, without injury to the animals, be easily effected, by occasionally opening windows and doors.

Coleman's method of ventilation, so much spoken of in England, consists in the tray-shaped standfloor, having a grated hole carrying out the urine by a gutter beneath. In front and above the head of the horse is a draft channel, leading upward, so that, by the cooperation of the gutter and chimney channel, a change of air is continually maintained, conveying the vapor through the chimney. This arrangement has only come into limited use, because the constant draft against the belly of the horse frequently produced colics and colds. Similar to this case seems to be the ventilation recommended by Henry Stephens,

in his book on rural and domestic economy. According to his method, there should be an opening in the front wall of every stand, above the head of the horse, so as to admit the necessary quantity of air directly to the nose of the horse. He says this method requiries several openings, which need not be large. These should be covered with perforated zinc, and, if the current of air should be even then too strong, it is advisable to interrupt it by a board, so fastened to the wall as first to drive the air upward before descending on the animals. Drafts at other places of the stable are deemed impracticable by Stephens, because the air thus admitted would, before reaching the nose, necessarily pass over the body of the horse, or fall upon his limbs.

It seems that the object contemplated could not be accomplished by this method, for the narrow and high openings will carry out the upper strata of heated air without admitting fresh air; if the latter should ever happen, such a current of fresh, and, under certain circumstances, of very cold air, rushing directly upon the head and forepart of the horse, could have but an injurious effect. A change of air should always be procured in those regions of a stable where the horses do not come into immediate contact, but where they do, equalization of temperature, and the mixture of air may be confidently left to Nature.

Those methods of ventilation are invariably best, which can always, and even when the horses are in the stable, be kept in operation without injury to the animals. Such are the air chimneys built perpendicularly into the ceiling, just above the passage-way, terminating above the roof.

It is well known that the heated strata of air, being specifically lighter, have always an upward tendency, assuming, in case they are not cooled off, a certain flight or draft, which is brisker in proportion to the height of the heated column of air thus put in motion. Simple openings above (without chimneys) will therefore bring about only imperfect motion and purification. The air which slowly moves up through the openings is cooled too rapidly by the temperature outside, so that it is soon interrupted in its ascent, permitting the cold air to rush in through the same passage. Those parts of air at a greater distance from the openings adhere, as it were, to the ceiling, become stagnant, and are not renovated. Quite different is the effect of the vapor chimneys referred to, setting at first the upper layers of air, and consequently all the rest in motion, because the draft generated by the long tube is just as strong as that produced by high chimneys. Vapor chimneys are sometimes used, but in their arrangement frequent mistakes are committed; in most cases they are too wide, if four boards are joined to form a conduit, as is commonly done, the current, on account of the width, being about one square foot, becomes too slow, for the ascending air is cooled before reaching the upper end of the channel; the watery vapors contained in the column will therefore concentrate and descend as rain into the stable. Therefore it becomes necessary to suspend a basin from the ceiling to catch the dropping water, which is apt to overflow upon the floor and on the animals.

But if the conduit is made narrower, perhaps half the width of the

boards and about one fourth of a square foot, the inclosed column of warm air will rise upward with more energy, forcing up the condensed watery vapors, which are in the act of falling back and preventing at the same time a current of cold air from rushing in through the same way. With regard to these ventilators, an essential advantage, usually lost sight of, may be gained to increase their effect by surrounding the conduit throughout its whole length with non-conductors of heat, so that the warm air in its rising shall not be cooled too rapidly. The advantages of such an arrangement are shown by the fact that air channels leading through full haylofts and out at the roof do not produce any dropping, not even in seasons of great cold. If by the consumption of the hay, which preserves the heat, the conduit is cooled, dropping will commence at the lower termination; therefore, if it leads through an empty space, it should be surrounded by straw, or be made of double boards, and further protected against humidity by painting the inside with tar. The terminus is protected from rain, snow, &c., by the application of a little roof, either of wood or sheet-iron, or by blinds. At the point where the conduit passes the ceiling, a valve or turning-dish should be placed so as to close the channel at will and regulate the current.

To promote ventilation in a still more rational way, openings which can be closed should, in my opinion, be made on the floor, at places where no animals stand, in order to supply fresh air in lieu of the warm air carried off; yet the doors and the cracks in the building will frequently do this, even in a greater degree than may be required.

At the outer terminus of the channels there is always a precipitation of humidity, tending to destroy the wall and the adjoining wood. Therefore, to lead away the discharged air to some distance from the building, by means of boards or projecting conductors, would be advisable. This is especially important if the openings are just below the roof, the wood-work of which is liable to destruction by the action of the vapors.

Cribs.—These serve the purpose of laying short fodder before the horses; for instance, oats, groats, beans, and choppings. Sometimes, also, they are used for receiving the drinking water. The height of the cribs, in most stables, is from three and a half to four feet from the floor, but it is more reasonable to adapt the height to the size of the horse, and most suitable to let the edge of the crib correspond in its height with the elbow of the horse. A lower position, it is true, would be more natural to the animals in feeding, but they would too frequently jump with their fore feet into the cribs, thus injuring the latter and themselves. Too high a position of the edge of the crib, on the contrary, would be inconvenient for taking food, and often cause the fodder to be spread about, as the horses, in order to avoid the upward stretching of their necks, turn themselves, with their mouths filled, from the crib, thus dropping the fodder in the act of chewing. A height of the crib equal with the withers, as it is frequently found in stables where small sized horses are kept, favors, and even incites to *cribbing*.

The width of the crib should be such as to allow even the largest horse to use his jaws with ease to the greatest extent; it should there-

fore be from ten to twelve inches. The length need not be more, strictly speaking, than the dimensions just referred to, thus giving a circular form ; but cribs are generally made longer than would seem necessary, because horses frequently stop eating and turn their heads aside, thereby losing fodder, if the vessel is so short as not to receive the droppings ; it should also be a recipient of the fodder falling from the rack. In this respect, cribs occupying the whole width of the stand are very suitable.

They are made either in the shape of gutters or of troughs. Their form should be such as always to collect the fodder again by itself in the middle, and confine it when stirred; there should not be any sharp angles, edges, or corners in and about the crib, because the fodder could not be reached everywhere with ease, and the horses are liable to hurt themselves by knocking, thus causing bony excrescences, especially on the lower jaw ; finally, the front exterior of the crib should always be well rounded, downward, so as to render the horses unable to remove the halter by means of the sharp edges.

Figure 4, plate 2 represents one of the most suitable cribs, having the advantage of the edge bent back and inward, preventing the throwing out of the fodder, being easier done in other cribs made either in the shape of gutters or troughs. This crib is made of cast-iron, in Wasseralfingen, usually weighs seventy-five pounds, and costs about three and a half cents a pound. The only objection is, that the angle formed by its perpendicular back wall and the rounded bottom is too acute, so that the horses can only procure the last particles of food by the exertion of licking them. In English stables, a special drinking trough is usually joined to the crib and rack.

With regard to cleaning, cribs made of cast-iron, stone, or delf-ware, and put into a frame, like a kettle into an iron hearth-plate, are very convenient.

The material used for cribs is wood, stone, or iron. Wood should be decidedly rejected, as it causes a great many injuries. Horses are tempted, by its use, to *crib;* it requires many repairs, and gases of bad odor and contagious substances will strongly adhere to it. The use of oak wood renders the expense not much less than that of stone, especially if it is considered that they require nails and sheet-iron coverings, making them even dangerous for the eyes of the horse.

Cribs running through several stalls, and made of one trunk, are expensive and wasteful of wood ; the heart of the wood is cut out, while the external and soft wood remains; repairs are difficult; and if the crib is of boards joined, angles and joints are produced, in many cases giving the first inducement to cribbing. All cribs, however, running through, should be provided with partitions for each horse, otherwise the envy of fodder will often excite quarrels.

Stone, under ordinary circumstances, can be best recommended as best for cribs. The only objection is that most kinds of stone are liable to a considerable extent to wear out all objects brought frequently in connection with them, for instance, the halter-chains, teeth, &c., besides, they are not cheap.

The long stone troughs are usually wainscoted at their lower edge down to the floor, partly to prevent injuries to the head and fore-feet

from the lower part of the trough, partly to gain a space for storing away litter, in which latter case the wainscoting should be provided with drop-doors capable of being locked. All these wainscotings are decidedly objectionable, being expensive and a chosen retreat for all vermin, rats and mice. To avoid the injuries indicated, the cribs should be well rounded, or the empty space filled out with a wall below. To keep litter in these places shows a want of rational arrangement. They are intended to hold the straw during the day, where it may dry, again to be used as litter for the night; but who would select so narrow and confined a space for this purpose? The dampness and gaseous evaporations from the straw is for the most part such as to injure the eyes, and the organs of respiration, with which they unavoidably come in contact.

In countries were stones are rare, earthen or delf-ware is frequently used for making cribs; they are clean and neat, but very fragile; those made of only one piece are a matter of luxury; but those composed of several plates, like earthenware stoves, are more generally used; similar to the latter are those constructed of burnt clay, as generally used in the northern parts of Germany.

Iron, on account of its hardness and durability, is especially adapted for cribs. In most cases they are made of cast-iron, and have the great advantage of preventing the horses from cribbing, of being rapidly and easily put up, removed, or transferred, in most buildings, and of retaining the greater part of their value, even in case of their being broken, or disused as cribs. A disadvantage connected with them is, that white horses, or such as have white marks about their heads, will frequently receive a dirty appearance from the rust of the cribs, giving, in point of cleanliness, a good deal of trouble to the hostler. To prevent oxydization several means are employed, the best still appearing to be that of enameling, or galvanizing, but the expense is considerable.

Another means of preventing this vessel from oxydizing consists in giving it a coat of oil, which, it is true, will not last long, if the crib is in use. If the latter is the case, a very corrosive or injurious rust will never be formed, this appearing only in the shape of a bronze color, as happens in the case of rifle barrels. If, however, the cribs are not to be used for some time, the corroding oxydization should be prevented by greasing or painting with oil.

Cribs of stone or wood are fastened either by walls below, by fixing them to the wall, or by placing them on wood or stone pillars. In running stables, cribs and racks are put up in one of the corners. In stands for mares, the foals are supplied with special cribs, rendered inaccessible to their mothers either by a pole laid across in the corner, below which the foals may still pass, or by cross-bars at the top of the crib, admitting only the small jaw of the foal to take the fodder from its reservoir.

In studs where there are many foals, the cribs may be so constructed as to be suspended from ropes, by which method the gnawing of the cribs can be avoided, because they are not steady, and may be drawn up to the ceiling, after feeding, so as not to trouble the foals in their quick movements, and to remove every inducement to crib.

In stables intended to receive cribbers, or horses inclined to crib, the

latter should be in a low position, about one foot from the floor, because it would then be impossible for the horse to indulge this propensity; and if he is, by being shortly tied, deprived of every other opportunity, for instance, the dividing pole, for cribbing, then this bad habit will sometimes in a brief period be entirely forgotten, never, under favorable circumstances, to be resumed.

Care should be taken, in making and fastening the cribs, so as not to leave cracks and openings, in which remains of fodder or single grains would lodge, as this would be the first incitement to cribbing.

Racks.—These are an apparatus of grated walls, of different forms, for the purpose of offering the long fodder to the animals, without any of it being lost or spoiled. A loss of fodder will be caused by being often trodden upon by the horses, and thereafter refused, besides, the fodder will be deteriorated by becoming damp in consequence of being breathed upon by the horses. The rack is trellised, to allow refuse, for instance, small stones, pieces of lime, and the pericarps of colchicum autumnale to get out of the fodder and fall through the trellis-work; besides it would be impossible for the horses to reach the fodder if the racks were not grated. The space between the rundles should be from two to three inches.

Racks are usually made over the cribs, at one and a half feet above the edge of the crib. The object of this high position is to accustom the horse to a fine erection of his fore part, a matter of consideration, as it is thought, in riding-horses, and possesses the additional advantage that the particles of fodder dropping through the rundles will fall into the crib, where they may be taken up again by the horse. These advantages, however, partly imaginary, partly real, as they are, are met by many disadvantages. The giving of food in such high racks is troublesome, and can hardly be done by small persons; the horses, also, are sometimes injured by the fork. It is impossible to prevent the head, mane, and eyes from being soiled by fragments of hay and other rubbish dropping from the rack, and giving rise to itching, rubbing, shoving off the halter, inflammation of the eyes, &c. The racks having a high position, more fodder will be dispensed and wasted, parts of which, for instance, straw of peas and beans, may even be liable to fall into the ears of the horse, giving a great deal of trouble.

These latter evils might be prevented by placing the racks somewhat back in the wall, or by bringing the front of the rack at least on a level with the wall itself, as is often seen in stables where the fodder is given from the barn, for instance, on the farms in Holstein and Hanover. The rundles in this case are given a perpendicular position, and the back part of the wall, not being trellised, forms an oblique plane, so as to enable all fodder to come gradually and of itself to the horse. High racks will always be accompanied by the disadvantage of forcing the animal, when eating, to give his head a tiresome and unnatural position, even dangerous to his health. By this forced position of the neck the circulation of blood is disturbed, causing perpetual congestions in some animals, especially those so predisposed. From all these considerations, I feel induced to advocate the position of racks used in English stables, where they are of equal height with the cribs,

being from three to four feet from the ground. It may be objected that this position would favor cribbing, and that the horses would sooner jump into the rack, spoiling it and hurting themselves; but if both cribs and racks are made of iron, and not altogether too low, these objections deserve no consideration.

The proportions of a rack should correspond to the method of feeding. Horses used for agricultural purposes receiving a greater bulk of fodder, especially green fodder in summer, necessarily require a larger rack, than those kept for luxury alone and receiving the smaller portion of their food in the shape of rack fodder.

The form of the rack should correspond to the crib, in case it is placed either above or side by side with the latter. It is objectionable to put up a long ladder-rack above a narrow tray-shaped trough of stone or cast-iron, the former stretching its ends over the trough, so as to let the fodder from the rack fall to the ground, both on the left and right side. In running stables, the crib and rack are frequently put up on different walls, or in different corners, in which case there appears no necessity for the form and size of the rack to correspond with that of the crib.

Figure 5, plate 2, illustrates this arrangement, made of one piece, by Cottam and Hallen, London, or by Brandon, Paris:

It costs, when of cast-iron	69	francs.
Enameled	59	"
Galvanized	100	"
Crib and rack of one piece	60	"
Enameled	79	"
Galvanized	88	"

The racks most generally in use are those in the shape of a ladder, with rundles at narrow intervals, either running through a number of stands, or separate for each stand. The latter arrangement has the advantage, that, if a rundle is accidentally torn off, the whole row of horses will not be exposed to excitement and danger. The position of these racks should be at an angle of 40° to 45° toward the wall.

Some have the rundles made movable, to facilitate the pulling out of the fodder, and to diminish their tearing and spoiling. For similar reasons, the racks in Holland and Belgium are provided with this arrangement: one of the rundles can be shoved up, and has a handle at the lower end, in the shape of a crutch handle, by means of which the horse is enabled to move up the rundle by putting in his nose, and to take out the fodder. (See figure 6, plate 2.) But I cannot ascribe any great value to this arrangement, inasmuch as in most racks of this kind, which I have seen, the rundles intended to be movable became so tight by the swelling of the wood, or the oxydizing of the iron, that the object contemplated could not be attained at all. Sometimes the racks are made of small boards, inserted into the grooves of the upper and lower ladder-beams, and in which the necessary openings are made by a saw. (See figure 7, plate 2.)

Racks in the shape of round baskets are of late frequently made, having the appearance of the fourth part of a large globe. They are made of iron only, being too small for green fodder, as at present

manufactured, but deserve to be recommended for stables where no green fodder is used, because they are of a pleasing form, can easily be put up, and facilitate the operation of drawing out the fodder. (See figure 8, plate 2.)

This rack, manufactured at the founderies of Wirtemberg, weighs from forty to fifty pounds, and costs about three and a half cents a pound.

The material for racks is either wood or iron. In ladder-racks, the beams are made of oak wood, on account of their being gnawed, and the rundles of ash, on account of its great tenacity. Racks made either of wrought or cast-iron are recommended for their durability, being, this considered, not much more expensive than wooden ones, which require frequent repairs. Those made of cast-iron must be provided with much stronger rundles than those of wrought-iron; they will last almost forever, while in cast iron ones the rundles are easily broken off by being struck with the hay-fork, by an accidental blow from the head of a horse, or by the animal being fastened to a rundle, &c. The damages thus done can often hardly be repaired; it is, however, always best to insert new rundles of wrought iron.

Arrangement for fastening the horses.—In this, care should be taken that the horses may not step inside the halter-chains, or straps, which can be avoided by putting weights at the ends of the straps. The arrangement as indicated in figure 5 deserves special commendation, the weights being shoved up and down on a leading pole, serving at the same time as a foot for the crib. These weights usually run behind the wainscoting, below the cribs, or in a covered channel, applied in one of the corners of the stand. If straps are used for fastening, rollers of iron, brass, or hard wood, should be fixed at the point of the wainscoting where the straps are shoved up and down by the weights, for the purpose of sparing the leather. If the horse is to be tied with but one rope, it must be in the middle of the stand, and so as to allow him to lie down without lengthening the strap considerably, and thus giving occasion to step inside. A leading pole from the edge of the crib should be put up, with a movable ring, to which the short halter-strap should be buckled.

SAXON MERINO SHEEP.

LETTER TO HIS EXCELLENCY JOSEPH A. WRIGHT, MINISTER TO BERLIN, FROM ALEXANDER SPECK VON STERNBURG, OF LÜTZSCHENA, GERMANY, RELATIVE TO SAXONY MERINO SHEEP, &c., &c. &c.

LÜTZCHENA, NEAR LEIPSIG, SAXONY, *July* 22, 1859.

DEAR SIR: I have much pleasure in giving you an account of the method of raising sheep, together with some information as regards the history of the Saxon merino, and other matters in connection with the agricultural pursuits followed on this estate, which may be interesting to your friends.

You are no doubt aware that Spain is the country to which the world is indebted for the "Saxon merino," the most perfect and noble of the different races of sheep. It has been proved that the Spanish sheep, more perhaps than any other domestic animal, is liable to undergo a great change, under different domestic influences, both with regard to size and wool; for, whilst the original Spanish merino has deteriorated in some countries so as to become nearly valueless, the reverse has taken place under the influence of a climate congenial to it. Thus, according to some historians, (Weckherlin, &c.,) the Spanish merino was introduced into England as early as the 15th century, and is now represented there by the south-down, or English short-wooled. In 1723 it was introduced into Sweden; yet how different now is their progeny. In England, the rich and ever-verdant pasturage and humid climate have developed and increased the frame and the flesh-producing qualities, whilst the fleece has also increased in size and weight, though at the expense of firmness and curl of hair, which constitute the properties of fine clothing wool. In Sweden, the uncongenial climate has effected the reverse, and changed the Spanish merino into a small, and in all respects indifferent, animal. The Spanish merino was first introduced into Saxony in the year 1765, when a flock of 102 rams and 128 ewes, increased, in 1779, by 55 rams and 169 ewes was presented by the Crown of Spain to the then Elector of Saxony—a circumstance from which is derived the denomination of "Electoral wool," 1st. 2d. Electa, in sorting, &c.—and by him located on his domains of Stolpen and Lohmen. These flocks, which were of the very best breed, and, so called, royal blood, are the source from which the whole family, not only of the Saxon merino, but also all the fine clothing-wool sheep in Austria, Silesia, Russia, (Odessa,) &c., and the countless flocks of Australia, have sprung, to the entire extinction, in some of these countries, of the aboriginal sheep. As it happened, the climate of Saxony proved to be extremely well adapted to these animals, for the wool produced from them soon became renowned for its fine clothing properties, so as speedily to eclipse the wools of Spain.

Thus, we find the exports from the respective countries of merino wool amounted to:

	From Spain and Portugal.	From Germany.
In 1800	7,794,700 pounds.	421,350 pounds.
At prices of about	10*s*. per pound.	7*s*. per pound.
In 1814	9,234,990 pounds.	3,595,100 pounds.
At prices of about	7*s*. per pound.	9*s*. 6*d*. per pound.
In 1827	4,349,600 pounds.	22,001,190 pounds.
At prices of about	4*s*. per pound.	13*s*. per pound.

The proportionate quantities of Merino wool exported from these countries were:

	From Spain and Portugal.	From Germany.
In 1838	1,814,000 pounds.	27,500.000 pounds.

The great profit from raising Saxon merino wool soon attracted the attention of landed proprietors in Saxony, indolent even as they were in matters of agriculture at that date, and the cultivation of sheep rapidly increased in Saxony, and extended to the neighboring countries of Austria, especially to Silesia, which, next to Saxony, produces the merino sheep in greatest perfection, exceeding, even now, in fineness of wool and exquisite staple, though unequal in some other respects. At the first, sheep-breeders crossed the Spanish merinos obtained from the Electoral flocks with the common country sheep, but the result was a failure, and experience soon proved the advantage of breeding pure merinos only, to the exclusion of other blood.

The time has now long since passed when the Saxon merino sheep, into which the Spanish merino was transformed, became a type, an animal of such fixed and permanently impressed properties as to form a particular kind of its species, and an independent race of sheep.

The late father of the writer, Maximilian Speck, Baron von Sternburg, was among those whose interests have been most closely connected with the history of the Saxon merino sheep.

Since the very commencement of the export trade in Saxon merino wool, previous even to 1800, Maximilian Speck, of Leipsic, having risen through industry and self-education from the very humble condition of a small village inn-keeper's son, became a merchant in the article, and, through his establishments at London, Leeds, Aix-la-Chapelle, and other places, supplied the increasing demand in foreign markets. About the year 1820 he also became a breeder of these animals, and interested himself in their improvement. Large flocks of them were kept by him, principally on this estate, and were subsequently also introduced by him on his two estates in Bavaria, though with indifferent success. The original or parent flock continues to be carefully kept up on this estate, to this day, though, of course, in diminished numbers. From this flock were drawn, in 1824 and 1830, some of the first supplies of the Australian Agricultural Society, at a time when Australia, as a wool-growing country, was still in its infancy. The sheep were exported from this place, together with shepherds, to the Australian Agricultural Company's possessions, on the river Upper Hunter, in New South Wales, subsequently visited

by the writer. By desire of the Emperor of Russia, Alexander I, several small flocks, from the parent flock here, were introduced by Maximilian Speck, in person, into the neighborhood of Taganrog and Odessa, (in 1825 and 1828,) from which the vast flocks of merinos in that part of Russia have in part sprung. Rams from this flock have, likewise, at different times, been exported hence to the United States, to the order of agents at New York; and so late as last year, the writer had the pleasure of forwarding a small flock of ten rams to Australia, selected here in person by that eminent stock-holder, Mr. W. J. Browne, of Port Gamble, Adelaide, South Australia, and of 13 Princess Terrace, Hyde Park, London, who was then on a visit to the different sheep-farming establishments in Germany, and gratified the writer by his assurance that, for pure blood and constancy, evidenced by uniformity and other essential breeding qualities, he had not found this flock to be surpassed anywhere.

I now proceed to give you a short account of my method of keeping these sheep, with attendant remarks. Their breeding being no longer so profitable here as to induce it, to the exclusion of other stock, the flock has been reduced for some years past to about 1,200 head, in the proportion of about 600 ewes, 80 to 100 rams, 250 to 300 lambs, and the rest wethers and yearlings. These are kept in one large stable, about 110 English yards long, 21 yards wide, and 9 to 10 yards high, built massively of brick, with pillars supporting a roof of strong wooden rafters, the whole forming a large, airy saloon, well ventilated by windows and air-holes near the top, to be opened or closed according to the weather and the season. The rams, ewes, lambs, &c., are all separated, divisions being contrived by sheep-hurdles, which, as well as the whole of the stable furniture, are light and easily movable. The hurdles are supported by stakes, which are driven in the floor at pleasure. Subdivisions of any size can thus be made quickly within the stable. The fodder-racks and troughs are very simple and practical, and could not be improved upon; but it would lead too far to enter into a description of them here. From the roof are suspended iron wicker-work baskets containing rock salt, necessary to keep the animals in health, and which they can lick at pleasure. Above the stable is contained the hay and straw loft, separated by wooden flooring, covered several inches thick with beaten clay, impervious to the exhalations underneath. From this loft the fodder is passed, through trap-doors and slides, to the stable below. The litter remains in the stable from 4 to 6 months at a time, sometimes attaining a height of 3 to 4 feet. Every day a little clean straw is laid down, which becomes mixed with the excrement of the sheep, and is compressed by them into one solid mass, forming the floor, which is perfectly dry, healthy, and sweet. The consolidated manure thus formed is not the least of the profits derived from the sheep. No other farm-yard manure is equal to it, and for turnip-crops, and especially for rape-seed, it is the very best fertilizer, as, not being exposed to the open air, and being well compressed, it retains its ammoniacal properties. The sheep are stabled all the winter, generally from the beginning of November until the middle of April, according to the season. As soon in spring as the weather permits and the grass begins to grow, they are taken

out to graze, in separate flocks, at from 9, a. m., to 12, m., and again at 3, p. m., till near sundown. For field and stubble-grazing they are very useful, as they keep the land clean, freeing it from weeds. This advantage is so essential to the farmer that some of my neighbors, not keeping sheep, frequently request me to take mine upon their stubble. During the six to seven months they are stabled for winter, their fodder consists of nothing but straw, the best of hay, turnips, and "grains" from the brewery. Of straw, necessary to the ruminating process, pea and oat straw are the best; next, barley and wheat straw. Rye straw is only given when other straw is exhausted. At the close of the harvest, a calculation of the probable requisites of fodder for the live stock, including the sheep, during winter, is made, as regards the sheep, on the following basis:

One-thirtieth part of the weight of the live animal in good hay is considered necessary, per day, for its sustenance. According to the quality of the fodder, and its abundance or scarcity, this may be increased to $\frac{1}{28}$ part; but less than $\frac{1}{30}$ part ought not to be given. Taking good meadow hay as the fodder-standard, a ram should receive about $3\frac{1}{2}$ pounds per day, a ewe about $2\frac{3}{4}$ pounds per day, yearlings, &c., in that proportion—taking the average of a full-grown ram at 110 pounds, of a ewe at 82 pounds, the weight of each varying, according to age, size, and condition, between 105 and 125 pounds, as regards the full-grown rams, and from 70 to 85 pounds, as regards the ewes. The weight of a wether varies between 80 pounds in lean condition and 110 to 115 pounds if strong and fat for the butcher. One pound of good meadow hay is considered equivalent to $1\frac{2}{3}$ pounds of oat, pea, wheat, or barley straw, 4 pounds of turnips, or 2 pounds of grain in the wet state, as daily delivered from the brewery, in winter. When the time of stabling for winter arrives, the sheep-master has his supplies of straw, hay, and turnips, allotted to him on the basis of the above calculation, and he is bound to make them serve out the proper time, under-feeding being as much guarded against as over-feeding and waste.

Straw is served out to all the sheep, but the lambs receive, in addition, hay only, the breeding ewes hay and turnips, grain being only given to the sheep set aside for fattening, and to the rams and yearlings in moderate quantity. Morning and evening the feeding racks are filled with straw, which, when "nibbled" out, is taken away and used for litter, a fresh supply being put in its place. Cleanliness, sufficiency, and due economy are the three considerations never to be lost to view.

Hereditary disease is unknown in my flock. Every lamb not appearing quite strong and healthy is killed when young. During the whole course of 40 years, epidemic disease has never made its appearance. The mortality from incidental disease and accident does not, upon an average, amount to more than two thirds per cent. These consist, almost exclusively, in a lamb being now and then crushed to death, and in death caused by rupture from distention, which, at the time of clover grazing, has to be much guarded against, especially in windy weather.

Each sheep is distinguished by a number, indicated by a small inci-

sion in the ear, made by an instrument, as soon as the animal is a year old. Early in spring, previous to the clip, and again in autumn, the ewes, rams, and yearlings are carefully sorted by myself and the sheepmaster, jointly, and the character of each sheep taken down, thus:

Covering register.

Ewe.	Fineness.	Size and stature.	Fleece and staple.	Age.	Ram.
No. 810	Supra or I. Electa, as the case may be.	Middle size, well formed.	Rather long; too open on back. Falls off about the haunches. Wiry character.	3 years.	To be put to No. 4 or 1.

If found too old, or otherwise objectionable, the number is crossed out, (to be substituted by a yearling,) and the animal thus rejected is marked for fattening, to be sold to the butcher.

For the purpose of covering, I keep five standard rams, besides two or three reserve rams. These are pent up in stalls, separately, and thus selected: No. 1, for its great degree of fineness and beauty of staple; No. 2, for the softness and mild nature of the wool; No. 3, for its size; No. 4, for its closeness of staple, evenness, and weight and size of fleece; No. 5, for its evenness and length of staple.

The reserve rams are set aside for similar good points, but none are taken for covering, the wool of which is not at least a I. Electa. The lambs are sorted and classed at one year old. For sale, for breeding purposes, the one year old ram is generally chosen. It ought not to be used for covering until from one and a half to one and three fourths years old, and is in its prime until four years old, but can be used until seven to eight years old. At two and a half to three years old it is full grown, and may then cover from sixty to seventy-five ewes a season, and from six to eight ewes each day during the season. The season for covering commences about the 1st of August or September, and lasts about a month. Ewes are not covered until two and a half years old. At covering-time, a trial ram, having its genitals tied over with a linen apron, is constantly admitted to the ewes, and directs the eye of the sheep-master to such as are in season, when they are taken from the herd and put to the standard ram previously selected for them and indicated in the covering register kept for the purpose. The study, of course, is to put a ewe deficient in a certain point or points to a ram distinguished for its perfection in these points, and thus to neutralize the shortcomings of one by the opposite extremes of the other. Breeding "in and in" may be carried far with sheep, without bad effects, but it has its limits. I introduce fresh blood to the extent of about five per cent. every year. For this purpose, I choose a ram, every four or five years, from some other standard Saxon merino flock, most likely to harmonize with mine. Mere fineness of hair has long since ceased to be the principal object aimed at. What we now endeavor to breed is, "a sheep of the greatest possible size of carcass and flesh

qualities, which, in the merino sheep, are compatible with fine clothing wool properties; no sheep to be below I. (in case of exception, only II. Electa,) and to have a fleece of at least two and one fourth pounds in weight."

It is an easy matter to breed for excessive fineness only. With a flock like mine, I have this so much in my control that I could, if so disposed, very greatly increase the degree of fineness, within three or four years, by crossing for that purpose only. The size of the carcass would then decrease, in proportion, to a certain point, and the weight of the fleece eventually dwindle down $1\frac{1}{2}$ to 1 pound, as is the case with some fine Silesian flocks. On the other hand, the carcass of the Saxon merino sheep cannot be increased beyond a certain size, unless at the expense of the staple, which, when the proper point has been exceeded, invariably becomes open on the ridge of the back, and what is called towy; the fleece, as it were, refusing to accommodate itself to an undue size of carcass. The practical experience of the breeder alone, joined to a knowledge of his flock, can offer a secure guide in the matter of judicious crossing.

The staff of servants attached to my flock consists only of one sheep-master and two assistant shepherds, besides occasional farm-hands, as may be required. During the grazing season, indeed, our excellent sheep dogs do half the shepherds' work, their instinct and training being wonderful.

As regards the prices I obtain for my sheep: The wethers, when fat, bring from 21*s.* to 26*s.* each; the ewes, fattened for the butcher, from 16*s.* to 21*s.* each. Breeding ewes are rarely sold, except for export. Their price is from £2 to £5, according to age, perfection, and fancy. Rams for breeding purposes vary from £2 10*s.* and £3 to £10 each. Picked yearling rams, for exportation, in flocks of from six to ten, or upward, £6 to £8 average price. Single rams of great excellence I have occasionally sold as high as £20, and even £30, but these were exceptional cases. Indeed, fancy has a great deal to do with the prices of fine stock. Provided a flock be of undoubted purity of blood, long standing, general excellence, and evenness of character, the probability is that any good ram from it will, if crossed with ewes from the same flock, produce sheep equal to it; and the chances are that a "fancy ram" from the same flock will not produce anything superior to the other, either from ewes of the same flock, or if crossed with others. Very extravagant prices are sometimes paid by fanciers for individual rams of great beauty, especially where the animal is for export; and the foreign fancy buyer will not be satisfied of the good quality of his purchase unless he has paid a high price for it. But, let it be remembered, single rams of great individual beauty are generally a mere *lusus naturæ*, a sport of nature, and often spring from flocks having less constancy of breed and blood, and by no means very reliable, but quite the contrary, for the reproduction of their own perfections. They are, in fact, show animals.

The prices I realize for my wool vary from 2*s.* 8*d.* to 3*s.* 2*d.* Last year I sold at 3*s.* 1*d.* This year, the market being depressed, I sold at 2*s.* 9*d.*, as clipped from the sheep, locks and all. The weight clipped this year amounted to:

From the ewes on the average....................	$2\frac{7}{16}$	pounds each.
From the wethers on the average................	$2\frac{1}{2}$	"
From the yearlings on the average	$2\frac{5}{16}$	"
From the full-grown rams.........................	4 to $6\frac{7}{8}$	"

I generally sell my wool, by private bargain, to France or Belgium, the best market for such wools, as best adapted for the fine, yet strong and sound fancy woolens manufactured there.

I conclude by giving a short sketch of my farming estate here. It is of medium size, consisting of about 650 English acres, of which about 90 acres are meadow land, 60 acres park and forest, 20 acres cultivated with hops, 20 acres yards and gardens, and the rest under the plow. The arable land is chiefly a good sandy loam, a small river running through the estate. It is divided into 14 principal parcels, or allotments, of from 20 to 50 acres each, and on this division is based a system of succession of crops. In this systematic arrangement for a constant change of crops on the same soil or field consists the most important improvement of modern agricultural science. Thanks to it, the productiveness of land in this part of the country, generally, may be stated to have been augmented by at least 20 per cent. as compared with the old slovenly mode of farming land, still in vogue with many of our peasantry, whom it is extremely difficult to prevail upon to depart from the way of their fathers. Having regard to the nature of your soil, and to your experience of it, you have so to arrange your crops as to bring about, systematically, constant suitable changes between agricultural plants of different vegetation, the rule being to cause opposites to succeed each other, and not to bring grain twice on the same field successively. Thus, for instance, wheat is the best possible successor, on the same field, to rape-seed, the latter drawing different chemical components from the soil, and imparting and leaving others most conducive to a good growth of wheat. Science has laid down certain rules in the succession of crops for the observance of the farmer, and the year, of course, known to you, still it may be of interest to quote my table of succession, "the law of my farm," which is never allowed to be departed from.

For 1859.

Field No. 1. Rape-seed, (25 loads, of 25 cwt. each, of farm-yard manure, per acre.)

Field No. 2. Wheat.

Field No. 3. Potatoes.

Field No. 4. Barley.

Field No. 5. Rye, (18 loads, of 25 cwt. each, of good manure, per acre.)

Field No. 6. Awelrape-seed, with buckwheat and stubble, turnips before and after.

Field No. 7. Oats.

Field No. 8. Turnips, (32 loads, of 25 cwt. each, of best stable manure, per acre.)

Field No. 9. Winter or summer wheat.

Field No. 10. Clover, for green fodder and hay.
Field No. 11. Rye.
Field No. 12. Peas $\frac{1}{2}$, beans $\frac{1}{2}$, highly manured.
Field No. 13. Oats $\frac{1}{2}$, rye, $\frac{1}{2}$.
Field No. 14. White clover, for pasturage.

In 1860, the crop, which in 1859 was on field No. 2, will be on field No. 1, and so on, in constant yearly rotation. I have, besides, some land set apart for lentils, mangold-wurzel, Indian corn, caraway seed, &c., and for lucern, a most valuable green crop in this climate. A change of seed is frequently made, and I often import, with a small extra cost of freight, and to great advantage, seed of the best kind from England.

All the crops are housed in barns, stacks are only made in case of great need. The grain is threshed by two threshing machines, one on "Garrett's" principle, the other on a Swedish model, both driven by working oxen. The sowing is done partly by hand, partly by the "Albanian" (American) sowing machine.

My live stock consists, at present, of about 1,150 sheep, about 62 head of cattle, (exclusive of 12 working oxen,) chiefly of the Bernese (Switzerland) and the Allgau (Tyrolese) breed. I have lately imported some English short-horns, of the best blood, with which I intend to cross, and expect a good result. I also keep about 80 pigs, of the common country kind, as well as Essex and Yorkshire middle breed. With these I cross the country or indigenous pig, which is rather lean, narrow, and bony, but the flesh of which is finer than that of the English breeds. By making one or two crosses, I produce a very excellent pig for the butcher, (who does not like the pure English breeds,) which fattens easily, and yet is not deficient in fine flesh. I obtain from 36*s.* to 41*s.* per cwt., living weight, for my pigs. This pays me so well, that I am about to alter my arrangements, and to make room for double my present stock of pigs.

In close connection with the farm, I have two technical establishments on the spot, namely: a brick work, the clay for which is found on the place, and which turns out 1,250,000 bricks per annum, and a brewery, producing about 160,000 gallons of Bavarian beer per annum, which is chiefly consumed in the neighboring towns and villages. I need not point out to you that the grains and malt-dust from my brewery are a most material accessory to my means for feeding the stock, and that the refuse enriches the manure heap.

To work the whole estate, I keep thirteen pairs of horses and six pairs of working oxen, their labor being always so arranged and disposed of as to concentrate it where most required at the time. Thus, at present, during harvest, nearly all are employed in hauling and threshing grain and doing other harvest work. During winter, when the earth is frost-bound, all are busy carting clay, on easy roads, for the brick-works, and so on. One branch, or department, must always help on the other, as best it may. I grind my own flour, bake my own bread, and kill my own meat, and have my own coopers, blacksmiths, wheelwright, and carpenter, on the place, so as to be independent of the tradesman, and to have their labor at hand when required. When nothing else is to be done, the coopers make casks in store, the black-

smiths and wheelwright work at new carts and implements; neither time nor labor is lost.

The price of land here, owing to the neighborhood of a large town, is rather dear—from £40 to £60 per English acre, arable land. Taking this in consideration, and the value of live and dead stock, buildings, and floating capital, I realize, in an average of years, a net interest of five and a half per cent. on the capital represented by this property, after allowing ten per cent. per annum for deterioration of dead stock, and two per cent. on buildings. This is no great interest, certainly, but a safe return, and combining an agreeable occupation with an independent and comparatively inexpensive country residence. The whole is conducted, under my supervision, by an able manager, with a staff of under-bailiffs and servants. Minute accounts of everything are kept, in sets of books arranged for the purpose, in charge of two clerks. I may add that there is also an agricultural school on the estate, licensed by government, where young men above eighteen years of age can learn something theoretically and practically about farming. It is a private undertaking, with which I am in nowise connected, except that it exists at my sufferance, the pupils profiting by what they may learn on the farm.

I shall be glad if you find anything to interest you in my letter. If so, may it serve as some apology for its length.

Believe me, dear sir, yours most truly and respectfully,

ALEXANDER SPECK VON STERNBURG.

His Excellency JOSEPH A. WRIGHT,
American Minister at Berlin.

SPLEEN IN SHEEP, AND ITS PREVENTION.

[Condensed and translated from the German.]

Different opinions prevail as to the causes, preventives, and remedy of this destructive evil. Generally, however, little or nothing has been done to prevent or check the disease. Many resort to medicaments of infusion, which process proves of no avail; others, when the disease has made its appearance among their flocks, deny it, or pretend to have suppressed it in its very outbreak. But all these mysteries cannot be attended with any benefit.

For the most part, the well-fed animals are affected by the spleen or milt-disease. They are seen dropping their heads, breathing laboriously, and moving their sides with great force and rapidity. They show uneasiness and dullness, others, however, are excited, and appear to be lively. The latter, as a general rule, are first stricken down with the disease. According to observations made by Dr. Wagenfeld, the skin is of a red appearance, passing somewhat into bluish, and the white of the eye presents a dark-blue stroke, passing into yellowish or brownish at the lower edge, the blood-vessels being of a dark-red color, and inflated. Yet, with many animals, there are no particular symptoms of disease to be observed; they stagger while grazing, and fall down as dead.

It is only by duration of the disease that the symptoms assume a more decided character. Melancholy, want of certainty in their steps, keeping behind the flock, abstaining from eating, dullness and loss of all sensation, are followed by heat and dryness about the mouth, tongue, and nose; their ears are cold, the pulse hard, and their looks fixed and staring. After a longer process, the pituitary membrane, both of nose and mouth, becomes blood-red, the latter exhibiting bloody foam, and violent gnashing of the teeth. The excrements are mixed with blood, and ulcers make their appearance about the neck and other parts of the body. The animals begin trembling, fall, are seized by fits, the white of the eye becoming red, and the eye-ball projecting from its cavity. If the progress of the disease is going on still slower, the breathing is performed in long and irregular intervals, blood is secreted from the nose and other orifices, and the urine is of a blood color, when death ensues, amid violent convulsions.

The disease is usually of such rapid character that often but few minutes intervene from its supposed commencement until its termination in death. A small number of animals thus attacked will live as long as from ten to thirty-six hours.

This rapid progress of the disease makes it extremely difficult to discern it, especially as the animals continue eating until they fall down. Decomposition speedily commences, developing most offensive odors.

The following are the results of dissection: The stomach is distended with offensive gas and food; the small intestines present an inflammatory appearance; the liver is tender, and overflowing with corrupt bile; the milt is swollen, soft, ulcerous, and often bursting; the brain is filled with blood; every part of the dead body emits a foul smell, the inside of the skin being always dark, and of a bluish-red color, caused by the blood beneath.

This plague is dangerous both to men and animals, not always, however, evincing the same power of contagion. In proportion to the slower or more rapid progress of the disease is the influence of its contagious nature; though sometimes there is nothing of this kind to be apprehended, when the animal dies very quickly, which is the reason why, in certain cases, only a few sheep are lost without the disease spreading further. In a slow progress, however, the contagion reaches the highest degree.

Those animals which die after a slow progress of the disease should be buried as deeply as possible, together with all their blood, foam, and the filth hanging about them; of those which die after a rapid progress, the skin may be taken, but the inner side of it should be immediately strewn with salt, or with lime-dust, which would be still better.

This disease makes its appearance most frequently in the summer months, and oftener in warm than in cold countries.

According to observations made by Mr. Reidemeister, of St. Petersburg, it is generated by great heat and dryness; by dusty pastures, and the dust raised by the wind, which the animals incessantly draw in; by rough treatment, and by over-feeding and fattening. Previous disorders of the abdomen may also be looked upon as among its causes,

as the milt, on account of its abundance of blood, is more affected than other organs. The principal causes, however, are found to exist in the watering places, inasmuch as the sheep are in the habit of drinking from stagnant and foul ponds.

In a disease so rapid in its progress, a special treatment of the several affected animals may be out of the question, though the most valuable may be subjected to such care. In this, we must first look at the nature of the disease. If there are symptoms of great heat, both about the mouth and horns, as well as a difficulty of breathing, we should bleed the neck of the animals until they faint, pour cold water on them for from eight to ten minutes, in intervals of two minutes each, and put bandages around them, of the breadth of six fingers, soaked with turpentine oil and strewn with the dust of blister-flies. Internally, they should receive, in half a glass of water, from two to three drachms of camphor, finely pulverized and dissolved with spirits; to this should be added from one and a half to two drachms of sulphuric acid, or, still better, some tincture of iron mixed with the water. Of this mixture the animals should be given a dose every hour. If there are any signs of recovery after the lapse of twenty-four hours, the mixture should be given only twice or thrice a day until they are completely restored. The boils should be cut and cleaned of the matter they may contain, after which the wound is to be washed with a mixture of water, vinegar, and kitchen salt. We must be careful in cutting them, so that the poisonous matter may not touch either the face or hands, which, as a protection, should previously be well oiled, or greased.

The following rules may be laid down to prevent the disease:

The sheep should not be kept in too fat a condition.

In the summer months they should not be exposed to the burning heat of the mid-day sun.

All running and chasing should be avoided; they should be led, and treated in a mild and gentle way.

They should be provided with new pastures every week.

They should not be allowed to graze in the neighborhood of dusty roads, frequented by carriages, so as to inhale the dust.

They should not be allowed to rest in valleys and low places, but only on heights, where they may enjoy the comfortable breeze, undisturbed by insects.

To deprive the milt disease of its contagiousness, the lambs should be kept warm in winter; for it is the severe cold, stormy, sharp, and changeable weather, that creates the germ, and which, if favored by circumstances, is very apt to assume the character of contagious disorder during summer.

Healthy sheep should not be allowed to come in contact with diseased ones.

Give them always pure water to drink; the greatest advantage would result from well-water containing iron.

At the appearance of any symptoms of disease, the sheep should be removed from their pastures as far as possible.

They should also receive proper medicines in the latter part of May.

For this purpose a mixture should be used, consisting of one part of

wormwood, (*Artemisia absinthium,*) one half of juniper berries, (*Juniperus communis,*) one part of gentian wort, (*Gentiana,*) one half of saltpeter, (nitrate of potassa,) one part of kitchen salt, and one part of bitter salt, (Epsom salt.) These ingredients, finely pulverized and mixed with eight or ten parts of bran, must be given to the sheep to lick.

A cheaper mixture consists of one part of wormwood, (*Artemisia absinthium,*) one part of gentian wort, (*Gentiana,*) one half part of saltpeter, (nitrate of potassa,) one part kitchen salt, one part of bitter salt, (Epsom salt,) one half part of vitriol of iron, and one part of tar. After a fine pulverization of all the ingredients, they are to be mixed with fifteen or eighteen parts of pure loam, and well worked. Of this mixture loaves of from fifteen to twenty pounds are formed, and dried in a moderate warmth, when they will be put in accessible places to be licked by the sheep.

If all these preventives prove ineffectual, the application of chloric water is highly recommended. For one hundred head of sheep, one part of chloride of lime is dissolved in water, and poured into the troughs. The animals should be induced to drink the chloric water by a dose of pure salt, given to them to be licked some hours before.

Mr. W. Reidemeister recommends the vitriol of iron as an effectual preventive. It is to be dissolved in the water intended for drinking. In other diseases of domestic animals, especially the atrophy of cattle, the tumor of horses, and even the diseases of poultry, it has been found a reliable cure.

ON THE PRINCIPAL PLANTS USED AS FOOD BY MAN.

SKETCH OF THE PLANTS CHIEFLY USED AS FOOD BY MAN, IN DIFFERENT PARTS OF THE WORLD AND AT VARIOUS PERIODS.

BY DR. F. UNGER.

[Translated from the German for this Report.]

Nothing has had so powerful an influence in changing the nature of the savage as becoming accustomed to a bloodless food derived from the vegetable kingdom. It is true, that plants contain the materials of the blood and flesh, but nutriment derived from plants is very different from that derived from animals. Instead of a deadly struggle for existence, the vegetable world freely yields up its best gifts without being essentially impoverished itself. The kernel, the ripe fruit, the tender, juicy sprout, the marrowy substance of the mushroom, even the farinaceous tuber and root, in their season of perfection and fitness for the use of man, usually only precede the period of their unavoidable decay and decomposition. That which is derived from the vegetable

world depends upon no strife with nature, and in the peaceful search after vegetable nourishment, man becomes himself peaceable.

It is quite reasonable to suppose that, in moving around vaguely in the forest and on the plains, by the sea-shore, and on the bank of rivers, the human race should ere long have discovered some esculent grain or nutritious root or fruit, even without taking into consideration what it might have learned from the instincts of animals. This much is certain: that with less rich endowments or gifts, the correct application of these materials to the necessities of his support, must have involved many labors and dangers, and the rectification of many mistakes.

From the various researches into the peculiarities of the vegetable kingdom, and from historical investigations, it may readily be shown that no portion of the earth's surface, even though of but slight extent, was originally entirely without nutritious plants. Nevertheless, it is equally certain that the original and natural distribution of such plants was very unequal in different parts of the world, whatever it may have since become through the aid of man and from other causes.

The vegetable world manifestly increases in variety with a milder climate, a warmer sun, and a less marked alternation of temperature. It is, consequently, not to be wondered at, that, with the increasing amount of heat in passing from the ice-encircled pole towards the equator, edible plants should increase in number, and their products gain in size and palatability. The cold portions of the northern and southern hemispheres produce few native nutritious plants, excepting such as algae, lichens, mushrooms, and some edible berries. The tropical regions, on the other hand, furnish a superfluity of farinaceous roots, and of sweet and juicy fruits, while the pierced bark of a tree (*Galactodendron utile*, H. B.) even supplies a nutritious milk. The East and West Indies, Central America, the coast of tropical Africa, are, in this respect, equally favored, each in its own way.

This is not the case, however, in the temperate zone, and especially in the warmer temperate regions of the earth. While the southern hemisphere can claim little prominence in this respect, the northern furnishes a large and varied series of nutritious plants, all important to its inhabitants. It is, nevertheless, remarkable how little the Western World can enter into competition with the Eastern in this respect, while the western portions of the latter (South Europe and North Africa), as also the eastern (China and Japan), are of much less importance when compared with its middle region.

All the investigations which we have been enabled to make, in reference to the native country of our most important cultivated plants, point unanimously to one particular district as most favored in its position, and from which the greatest number and most important of plants have been derived. It is that which is encircled by the great inland seas of the earth, namely, by the Persian and Arabian gulfs, the Mediterranean, the Black, and the Caspian seas. From the slopes of the Caucasus, of Taurus, and of the Albors, not only do our most generally distributed fruits derive their origin, but the cereals also; and if we are not able to detect and to recognize the progenitors of these plants

in their native localities, yet history shows Armenia, Persia, Mesopotamia, and Syria, to have been their cradle. Even if there were no other mode of determining the locality of Paradise, the point of radiation of all European civilization, our knowledge of the origin of the most nutritious plants would enable us to establish its position.

It is a fact, by no means to be kept in the back-ground, that hardly one of the plants, the products of which are used for purposes of nutrition, is pleasant or palatable in its original condition. Their different methods of culture, their transportation to portions of the earth remote from their place of origin, and the varied operations of Nature by which changes are induced in size, character, texture, and chemical constitution, have, little by little, caused them to differ from the original just in proportion as the hand of man has cared for them. This has caused the cereals and the tuberous plants to be more nutritious, and has rendered the vegetables of the kitchen-garden and fruits more palatable. How great a difference exists between the wild original plants, and those altered by the agency of man, is shown by our roots, as the turnip, the parsnip, the shallot, &c.; and such fruits as the pineapple, banana, grape, strawberry, &c.

Even when long-continued effort is not sufficient to effect a desirable change in the plant, it is often possible for man to make use of as food. Who does not know that the farinaceous root of the Mandioca, or Cassava, (*Jatropha manihot*, L.), is not only unpalatable but actually poisonous, on account of the hydrocyanic (prussic) acid in its milky juices. The native, however, has for a long time obtained a substance, by pressing out the grated root, and by washing, drying, and toasting, which serves him for his daily bread, and furnishes at the same time a starch (tapioca) useful for various purposes. The same is the case with various other tuberous substances, as, for instance, the Takka, the *Dracontium polyphyllum*, &c.; as also with fruits and seeds, where portions must be removed and altered in order to render the rest fit for use.

How simple a treatment of many of the farinaceous plants is sufficient to prepare them for food, is shown, for example, by the Tarro root (*Arum esculentum*, L.), the Bread fruit (*Artocarpus incisa*, L.), the Sweet potato *Convolvulus batatas*, L.), and others, which require only to be crushed or grated to furnish daily nourishment. When the pulp of such plants passes into fermentation, or is subjected to the influence of fire, its nutritious qualities and palatability are increased; should spices be added to promote digestibility, or if combinations of different vegetable substances be effected with materials of an animal character, we have the first germ of the art of cookery before us. It is quite probable that the greater mass of mankind has not gone beyond this primitive condition of the art to its more refined modifications.

The farinaceous plants unquestionably constitute the basis of all vegetable nutriment. Starch and different protein substances are the most important constituents of such portions as are used for the purposes of food. Nevertheless, an accumulation of these substances is not to be found in all plants, and just as little in all parts of one and the same plant. They are mostly garnered up in tubers, in roots, in the pith of stems, in fruits, and in seeds. These, therefore, have usually

been sought after by man and introduced into the circle of his household economy, whenever this became fixed on a firm basis. The attempt to remove the small seed-like fruit from the various graminous plants, or to test the thick fleshy fruits in reference to their possession of nutritious substances, was as important to man as to animals. For this reason the seeds of the grasses, and many fleshy tuberous roots, have played the most important part among all cultivated plants, and their multiplication by cultivation first enabled man to produce them in greater number in a given space, and thereby to begin his own political and moral development.

It is interesting to observe how almost every portion of the earth has originally possessed its own breadstuff, which has thereby characterized the life of its inhabitants. While Europe derived its bread from oats, Northern Asia from barley and wheat, and Southern Asia from millet and rice, the Indian millet in Africa, and the Indian corn in America were the most important plants of cultivation. Australia alone was originally deficient in this respect, but the intercourse of nations, which soon by degrees distributed all the *Cerealia* over the whole inhabited earth, has also enriched this country, which seemed to have been so parsimoniously treated by Nature.

The common oat (*Avena sativa*, L.), the true native land of which is no longer known, although the region along the Danube may pass as such, may be legitimately considered as the European bread crop. The Celts and the Germans, as far as we can ascertain, cultivated it two thousand years ago, and it seems to have been distributed from Europe into the temperate and cold regions of the whole world. The names *Avena Oves*, (Russian), *Owes* (Bohemian), *Owies* (Polish), *Oats* (English), have great similarity to the words *Hafer* and *Hauer*, while on the other hand, the Tartarian name *Sulu*, the Hungarian *Zab*, &c., point to a different origin from the former. The Illyrians, besides the names mentioned, had still others for it. It was known to the Egyptians, Hebrews, Greeks, and Romans.* With the introduction of more nutritious and better cerealia, the oat became more and more restricted to poor soils and inhospitable regions, and at the present day it principally serves as food only for domestic animals and the poorer class of people. In Scotland, bread is baked from it even now, as was formerly the case in Germany. The Oriental or Tartarian oat (*Avena orientalis,* Schreber) was first brought from the East to Europe at the end of the preceding century.

Barley (*Hordeum vulgare,* Linn.), according to Olivier (Voyage en Persie, 460), in his time grew abundantly wild in the historically-important regions between the Euphrates and Tigris. Willdenow is inclined to place its native country towards the bank of the Samara, a tributary of the Wolga. We are enabled to give the native land of the two-lined or common barley only, (*Hordeum distichum,* L.) with some certainty. C. A. Meyer found it growing wild between Lencoran and Baku; C. Koch, on the steppes of Schirwan, in the southeast of the Caucasus; and Th. Kotschy, in South Persia. The six-lined or winter barley (*Hordeum hexastichon*) has been known the longest of all. The

* Plin. Hist. Nat., xviii, p. 17.

Egyptians, Jews, and Indians cultivated it in the earliest times, and grains are found in the mummies of the Egyptian catacombs. The rice or battledore barley, (*Hordeum zeocriton*, L.), formerly more abundant than now, furnishes an excellent meal, and in this respect is distinguished among the other species. The common barley came to Europe by way of Egypt, where, at the present day, the two and the six-lined are still cultivated. Even in Greece, all the three kinds of barley were formerly cultivated, (*Κριθη*, Theoph., *Κριθαρι* of modern Greece,) while at the present day only the common and the six-lined barley are cultivated and used as fodder for horses. The Romans were acquainted with the two and the six-lined barley. In connection with the oat, it has extended its dominion in Europe to beyond the polar circle, and near to it in Asia and America, while the cultivation of these two *Cerealia* is most prevalent in the Arctic Circle, in the eastern portion of the continent, as well as in the greater portion of the subarctic zone also.

The Celtic word *Secal*, or *Segal*, as also the German *Rog*, *Rya*, and the Sclavonic *Rezi*,* used to indicate one of the most important *Cerealia*, namely, the rye, (*Secale cereale*), point to its origin in the region between the Alps and the Black Sea. Neither the Indians nor the Egyptians were acquainted with the rye. The Greeks received it (*Βριζα*) from Thrace and Macedonia. Pliny mentions its cultivation at the foot of the Alps. Other species of *Secale* grow in southeastern Europe and western Asia, as for instance, *Secale montanum* in Sicily; *Secale villosum* on the Grecian Archipelago; *Secale fragile*, Bieb., in the Caucasus; and *Secale anatolicum*, Boiss., in western Armenia and Asia Minor. The different varieties which have been produced under the influence of cultivation, immediately disappear in a change of the same. At the present day its cultivation in Europe and Asia takes place between 50° and 60°, and in America between 40° and 50° north latitude. In Gulbransdale, (Laurgard), at 62° north latitude, I found fields of rye at an elevation of 1,030 feet above the level of the sea, the size of small gardens, and, like them, fenced in with boards.

Wheat (*Triticum vulgare*, Will.), which is the most important and widely distributed of all bread-stuffs, according to the Grecian fable, was originally native on the plains of Enna and in Sicily, but it is much more probable that, like barley, it was received from Central Asia, where Olivier seems to have found it growing wild on the banks of the Euphrates. In any event, it belongs to the longest cultivated cerealia. Even Theophrastes was acquainted with it; (*πυρος*), probably the grained summer variety, from which the winter wheat seems to have been subsequently developed. In a similar manner, Scripture points to its cultivation in Palestine. Even in China it was known 3,000 years before Christ as a cultivated plant. As Isis was supposed to have introduced wheat into Egypt, and Demeter into Greece, so the Emperor Chin-nong is said to have introduced it into China. The great variety of the ancient names used for indicating this plant points to the wide circle of distribution which it originally possessed. At the present day, wheat is cultivated in all parts of the earth, having

* Not *zyta*, which means grain in general.

been taken to America by the Spaniards, at the beginning of the sixteenth century.

Besides the common wheat, several other species of wheat are to be considered as cultivated plants, although they have attained a much more restricted distribution. Among these may be mentioned the *Triticum turgidum*, L. which was cultivated even by the ancient Egyptians, and was known to the Romans in the time of Pliny. As it has not even yet reached India, its native land is to be looked for rather to the south and west of the Mediterranean than in Central Asia.

The many-eared or Egyptian wheat (*Triticum compositum*, L.), is only a variety. It is cultivated chiefly in southern Europe and in England.

Two species of wheat, *Triticum durum*, Desf., and *Triticum polonicum*, L., or Polish wheat, are only cultivated to advantage in the warmer regions of Europe.

The Spelt (*Triticum spelta*, L.), at present cultivated only in Europe here and there, was met with even by Alexander the Great as a cultivated plant in his campaign in Pontus. Its origin in Mesopotamia and Hamadan, in Persia, is not doubtful; especially as its cultivation in these countries cannot be carried back to any very remote antiquity. It is called *ὄλυρα* in Greece, (Herodot. II., 36), and it likewise seems to have been known in Egypt, even though at the present day it is not found there. The German name *Spalt* points to its early cultivation in Germany.

We come finally to the little cultivated one-grained wheat, (*Triticum monococcum*, L.); this is the *Kussémeth* of the Scriptures. From it the Syrians and Arabians made their bread. Its cultivation has not extended either to India, Egypt, or Greece. Both the Crimea and the region of Eastern Caucasus have been indicated as the native country of the one-eared wheat. The *Emmercorn*, or German wheat, (*Triticum amyleum*, Serv.), has had an equally ancient cultivation: this is the *Ζειὰ δίκοκκος* of Dioscorides. It is cultivated more frequently in the southern than in the middle portions of Europe.

Wheat occupies a broader belt than rye, and is cultivated as the principal crop in middle and southern France, England, (where it constitutes the chief object of culture among the cerealia), a part of Germany, Hungary, the lands of the southern Danube, the Crimea, and in the lands of the Caucasus, as well as Central Asia, wherever the soil is cultivated; along its northern border it is associated in culture with rye, in the southern with rice and maize, (Indian corn.) The latter is chiefly the case in the North American States, and in the region of the Mediterranean. Wheat is even cultivated in the southern hemisphere, at the Cape, Buenos Ayres, and Chile, wherever the climatological conditions will allow it.

While wheat is richest in gluten, and therefore the most nutritious bread crop, rice, (*Oryza sativa*, L.,) although serving for the nutriment of much greater numbers of men, possesses, nevertheless, a much less capacity of producing blood. Indigenous to Further India and the Isle of Sunda, it is extended over the whole of Southern and Eastern Asia, as well as over Arabia, Persia, and Asia Minor; thence it has

reached on the one side to North Africa, Egypt, and Nubia, and on the other to Greece and Italy, (A. D. 1530.) Rice was already introduced into China 3,000 years before Christ. The Greek words ορυζον (Theoph.), *Ορυζα* (Diosc.), were manifestly derived from the Sanscrit *arunga* and the Cingalee *ooruwee*, (*Urui*.) Even in the time of Strabo, rice was cultivated in Babylon, Susiana, and Syria. The Arabians brought it to Sicily. It is only very recently that it has been taken to America. In the African as well as in the American tropical regions it is, however, less exclusively cultivated than in Hindostan, where the people live almost entirely on rice alone.

Rice occurs in a great number of varieties, such as mountain rice, valley rice, summer and spring rice, &c. The different kinds are distinguished not only according to their taste, but also according to their smell.

What rice is to the Old World, maize, *mahiz* (*Zea mais*, L.), or Indian corn is to the New. It was cultivated there at the time of the discovery by Europeans. It is probably indigenous to Central America, and brought by the Toltecs to Mexico. The first European settlers in Pennsylvania (1584) even then found rich fields of maize. The Indians on the Arkansas eat the green ears as their every day food. The Peruvians bake various kinds of bread from its meal. At the present day, maize is the most common article of nutriment of the lower and middle classes in Peru and Central America, and the commencement of its cultivation in these countries is enwrapt in the same degree of fable as the culture of our cerealia. The Mexican Demeter, Cinteutl, (from *Cintli*, maize,) like the Grecian Demeter, was honored with the firstlings of the fruit dedicated to her. The many varieties which are known of the maize, as well as the circumstance that at the present day we are unable to point with certainty to the original species, indicate clearly a very extended period of cultivation for this plant.

Maize was unknown to the Europeans before the discovery of America, and has been extensively distributed in other parts of the world, especially in Europe since the seventeenth century. That the wheat of Theophrastus, a grain the size of an olive kernel, cannot be maize, I consider to be well established, just as certain as it is that his *ζέια* is not maize, but spelt. In Germany, it is called Turkish wheat; in Greece, *arabositi*. Neither in Egypt nor in India and China did its culture precede the discovery of America. The cultivation of maize in America does not extend beyond the southern tropic, although it passes the Tropic of Cancer to the north almost to 50° north latitude. On the western coast of Africa its cultivation is confined to the tropics, while more to the north it is at home in all the lands bordering the Mediterranean.

The common millet (*Panicum miliaceum*, L.), derived from the East Indies and other warmer regions of Asia, has not had the same favorable reception as rice, although yielding little to it in its distribution. It was known to the Greeks and Romans at the time of Julius Cæsar, and is the κεγχρος of Strabo, who states that it thrives excellently in Gaul, and is the best protection against famine. The Sclavonians are very fond of a dish of millet, (*Kasha prosna*.) It was

probably this grain and not the Indian millet that the Emperor Chin-nong introduced into China more than 3,000 years ago.

Another species of millet (*Panicum frumentaceum*, Roxb.), is frequently cultivated for food in the East Indies. The ear millet, or the *Fennich* (*Setaria italica*, P. B.), which at the present day is cultivated in Southern Europe, and even here and there in Central, is of East Indian origin, since even the ancient Greeks knew it as ἔλυμος, and the Romans as *Panicum*.

The *Himmelthau*, or the manna grits (*Digitaria sanguinalis*, Scop.), is of less importance. The small hulled fruit furnishes a wholesome and palatable nutriment. Indigenous to Europe, it is cultivated here and there on poor, sandy soils.

The common Indian millet (*Sorghum vulgare*, Pers.), which was introduced with rice by the Arabians into Egypt, is to be considered as a characteristic plant of Africa, not because it was originally indigenous there, but because it is principally cultivated in this country, (east and west coast, northern half to Timbuctoo; in Abyssinia, from the level of the sea to the height of 8,000 feet.) Although its native country cannot be positively ascertained, it can scarcely be any other land than India. Even in the time of Pliny* it was known in Europe, and in the thirteenth century had extended to Italy, and at the beginning of the sixteenth century reached France, under the name of Saracen millet. At the present day, it is distributed throughout the whole of Southern Europe, and is raised to advantage in Hungary, Dalmatia, Italy, and Portugal. The different varieties of the Indian millet, however, are not well-defined at the present day. It is doubtful whether the *Sorghum bicolor*, Willd., and the *Sorghum usorum*, N., are entitled to a specific rank.

To these important cerealia may be added some other plants belonging to the grasses, as well as to other families. Here belongs the *Tef*, (*Eragrostis abyssinica*, Link), *Eleusine tocusso*, Fres., and *Eleusine coracana*, Gärt., *Pennicillaria spicata*, Willd.; also, *Amarantus frumentaceus*, Buchan†., *Polygonum fagopyrum* and *tartaricum*, and the *Chenopodium quinoa*. These, however, with the exception of the last two genera, are confined to particular regions and are nowhere used exclusively as an article of food.

The *Tef* (*Eragrostis abyssinica*, Link) is a mountain plant of Abyssinia, cultivated everywhere there, at a height of from 2,500 to 8,000 feet, where gentle heat and rain favor its development (in July and August.) It furnishes the favorite bread of the Abyssinians, in the form of thin, highly-leavened, and spongy cake. Four varieties are cultivated of this palatable grain.

The *Dagussa* (*Eleusine tocusso*, F.) furnishes a poorer bread in Abyssinia, and although cultivated at a height above the sea of 4,000 to 7,000 feet, thrives particularly well in hot and warm regions. There are three varieties, with black, reddish-brown, and white seeds. Its native country is the East Indies.

The *Eleusine coracana*, Gärt., furnishes a grain similar to the millet

* Pliny, xviii, page 7.

† Pliny, xviii, 7.

in abundance of flour, although inferior to the preceding species in quality. It is cultivated on a large scale in the East as well as the West Indies.

Eleusine stricta, Roxb., is, perhaps, only a variety of the first.

The Brush-grass (*Pennicillaria spicata*, W.), with its numerous varieties, is derived from the East Indies and distributed over Egypt and the neighboring regions. The seeds, which are rich in flour and similar to those of the millet, constitute the principal article of food in several countries. Various tribes of negroes subsist almost entirely upon it on their travels.

Buckwheat (*Polygonum fagopyrum,* Link) was first brought to Europe at the beginning of the sixteenth century, having been unknown both to the Greeks and Romans. From the northwestern region of the Chinese empire, whence came the great devastating hordes of mankind, its cultivation has extended in some unknown way to the coast of the Mediterranean, and thence it has been still further distributed by the Saracens, whence its name *Sarasin*, *grano Saraceno*, *blé Sarasin*. The Polish, Bohemian, and Levant names, *Tatarka*, *Tattar*, very clearly point to its original native land and its first distributers, as also do the Russian, Lithuanian, and Polish terms, *Gretscha*, *Gryka*, *Grikki*, &c. to the intervention of the oriental Greeks. The names buckwheat, (beechwheat,) fagina, and the other different names of this plant, are connected either with the mode of its introduction, or are based upon the form of the fruit.

While the buckwheat has a very extended culture in the whole of Middle and Northern Europe, as well as in Northern Asia, in Northern India and Ceylon it is confined to narrow limits, and is there of very recent introduction.

The *Polygonum tartaricum*, L. is of the same origin as the buckwheat, though it is much less widely distributed, and was introduced at a much later period into Europe. The same may be said also of the *Polygonum emarginatum*, Roth., chiefly cultivated in China and Nepaul, the native country of which is along the borders of China and Northern India. The Quinoa (*Quinoa chenopodium*, Willd.), constituted the most important article of food of the inhabitants of New Granada, Peru, and Chile, at the time of the discovery of America, and at the present day is still extensively cultivated on account of its rich yield. A variety, with light and more mealy seeds, has arisen in cultivation from the original species with dark seeds, and is now raised more than the former. It is not known at how early a period it was cultivated, although it is remarkable that it has been disseminated but little from the plateau of the Chuquito. The white Quinoa is cultivated in Europe more on account of its leaves which answer instead of spinage, than for the seeds, which are used chiefly as food for poultry.

The *Amarantus frumentaceus*, Buchan., Roxb., in the East Indies, furnishes an equivalent to the Quinoa. The seeds of this plant supply an important article of food to the native races. It is frequently cultivated on the mountain slopes of Mysore and Coimbatore.

We may here mention some grasses and other plants which are here and there used as furnishing flour in a general deficiency of other food.

Among these are *Glyceria fruitans*, some species of *Bromus*, the *rhizome*, and root of the *Triticum repens*, the seeds of *Calla palustris*, *Ranunculus ficaria*, *Arum maculatum*, *Brionia alba*, *B. dioica*, and *Butomus umbellatus*, which, in Norway, often serves as material for bread, and the seeds of the *Croix lacrima* which are used as food in Tongatabu and Euwa.

Certain roots and tuberous root-like shoots are rich in starch though not abounding in albuminous substances. To a limited extent they serve to replace the above-named cerealia, if not to supplant them, and may, therefore, when cultivated, serve whole nations for food. The potato (*Solanum tuberosa*, L.), the sweet potato, the mandioca, the yam (*Dioscorea alata*), the Takka (*Tacca pinnatifida*, Forst.), and the Tarro (*Arum esculentum*). While the first three belong to America and have been propagated thence to other parts of the world, the last three are the true bread plants of New Zealand and of the islands of the Pacific ocean, and may have served the inhabitants as the first means of nutriment just as the root stalk of the Papyrus and *Nymphœa lotus* did the old Egyptians.

The potato (*Solanum tuberosum*, L.) is not only one of the most important of farinaceous plants for America, but has become such for Europe and the other parts of the world.

It is beyond a doubt that the potato, at the time of the discovery of America, was already cultivated in the greatest portion of the Andes of South America, and even from Chile to New Granada, although at that time it was not known in Mexico, and only shortly afterwards in North America.

The potato is a sea-shore plant, peculiar to a hilly and rocky soil, and now grows wild in Chile and the neighboring islands (Chiloe and Chonos, about 45° south latitude) to Peru, (Lima). In this wild state it rarely extends more than a few miles inland, and is widely different from the present cultivated potato. Its flower is always white, its tubers at the best attain a length of two inches, while its taste is insipid, but not bitter. Besides the original plant of the cultivated potato, which even in its wild state has passed into several varieties, (according to Hooker, jr., into five varieties), there are found in the East and West Indies still other kinds of *Solanum* with the tips of the shoots thickened into tubers, as *Solanum commersonii*, Poir., *Solanum maglia*, Dun., and *Solanum immite*, Dun. In the Argentine republic, especially in the mountains of Famatina, a potato grows wild, which at the time present is cultivated at Chilecito.

Even in Mexico, where the *Solanum tuberosum* was certainly introduced at a late period only from South America, there are some species of *Solanum*, such as *Solanum demissum*, Lindl., *Solanum cardiophyllum*, Lindl., and *Solanum verrucosum*, Schlecht., the latter of which produces very palatable but small tubers.

The potato was first brought to England from Carolina in the year 1586, and found its way over the rest of Europe in the seventeeth century; but it was not until the nineteenth century that it obtained its fullest reputation. At the present time, in innumerable varieties, it sheds its blessing over all the lands of Europe to the furthest north. I have seen a truly romantic potato field, the last one to the north,

situated upon an enormous mass of rock which lay near the road between Dalevaagan and Dalseidet, (near Bergen, in Norway.)

The mandioca plant (*Jatropha manihot*, L.) possesses an extremely farinaceous root, (one variety, as already mentioned, with a sharp poisonous juice, the other without it,) and may be ranked among the most important of nutricious plants in tropical America. Pohl has shown, however, that the two may be considered as distinct species, and has called the first *Manihot utilissima*, and the other *Manihot aipi*. Both species were cultivated by the inhabitants of Brazil, Guyana, and the warmer portions of Mexico, when the first Europeans landed, and even at that time they had passed into a great number of varieties. Brazil, in which alone forty-six different species of manihot are found, is undoubtedly to be considered as the native country of both the above-named kinds, although they have not yet been found growing wild there. Pohl has even expressed the opinion that *Manihot pusilla* is the original stock of *Manihot utilissima*, which is, however, doubtful.

The mandioc was naturalized in the Antilles as early as the sixteenth century, although its journey around the world, by way of the Isle of Bourbon and the East Indies, took place at a comparatively late period. It reached the west coast of Africa earlier, and the erroneous opinion has even been entertained that it was transplanted from Africa to America.

Of as great, if not greater, importance than the mandioca is the Sweet potato, (*Convolvulus batatas*, L., *Batatas edulis*, Choisy). It is one of the most widely distributed cultivated plants of South and Central America, and it, as an article of food, passes back to the earliest historic period. In Brazil it is called *Jetica*, in Mexico *Camote*, words, the roots of which, belong to the original tongue of the country. The name *Batatas* is a corruption of *potato*. Even upon the Antilles this useful plant was found cultivated in numerous varieties as early as the year 1526. Columbus brought it with other novelties to Europe, and presented it to Queen Isabella; the consequence was that this plant, which is suited to the climate of Spain, was immediately cultivated there. C. Clusius mentions that as early as the year 1601 he had eaten it in Spain.

The sweet potato was first brought by the Spaniards to Manilla and the Moluccas, and thence by the Portuguese distributed over the entire Indian Archipelago. Its names in these countries are never of Malayan, but altogether of Castilian origin. This plant soon reached China, Cochin-China, and India, although when and how is not known at the present time. There is certainly a Chinese, as well as a Sanscrit name for this plant, although this seems to be of more modern origin. The sweet potato has been even believed by some to be of Asiatic origin, or that the American and Asiatic plants are to be considered as different species. Neither of these suppositions is probable on historical grounds, and on account of the fact that the fifteen species of this genus hitherto known are peculiar to America, four of which only have also found their way to other parts of the world. The sweet potato has not been found growing wild by any one, although the tropical portion of America is to be considered as its native country with most show of probability.

The *Ipomœa mammosa*, Choisy, a native of Amboyna, another con-

volvulaceous plant, with edible root, is cultivated in Cochin-China, and may be the same plant which is raised as a variety under the name of *Umara* (*Convolvulus chrysorhizus* (Soland.?), in Otaheite, of the Sandwich Isles, the Eastern Isles, and Northern New Zealand.

The Arum root (*Arum colocasia* L.), on account of its farinaceous tuberous roots, is one of the most important plants of the tropics. It is very probably an Indian plant, which is cultivated in the whole of Central Asia, in very numerous varieties, under the sanscrit name *Kuchoo* (*Kutschu*). Here and there it is found running wild, though nowhere growing truly native. It was carried westward in the very earliest times, and with *Nelumbium speciosum*, cultivated in Lower Egypt, particularly towards the Delta of the Nile, where it is now grown under the name *Colcas*, Kulkas; while the *Nelumbium* has long ago again disappeared. The Greeks meant the *Nelumbium* by their *κολοκασια*, supposing the root sprouts to be used as food. They were manifestly wrong in this, however, since the root is of very little use on account of its fibrous texture. The Spaniards received the Aron root from the Egyptians, which they cultivated in the southern portions of their country, although it become quite at home there.

We are at present unable to say, with certainty, how far the Aroideæ, cultivated in Ceylon, the Sunda Islands, and the Moluccas, belong to this or to other species. It is also more or less doubtful whether the Tarro or Tallo (*Arum esculentum*, Forst.), does not in all probability represent the same species; a supposition which, besides the similarity of the characteristics of the two plants, is corroborated by the fact that the *Arum colocasia*, in Java, is known by the name of Tallus, which is probably identical with that of Tallo, used on the South Sea Islands. It is not even improbable that these islanders may have become acquainted with this plant on their voyages to the west, and brought it back with them.

The Igname, or Yam (*Dioscorea alata*, L.), is a plant cultivated in the tropics of the whole earth on account of the nutritious qualities of its root, although far inferior in excellence of taste to the sweet potato. This root is very much prized, and it often attains an enormous size, and a weight of from thirty to forty pounds. The Indian archipelago and the southern portion of the Indian continent, is the starting point from which this, the most cultivated species of *Disocorea*, has spread. Thence it was first carried to the eastern coast of Africa, next to the west coast, and from thence to America, where the names Yam, Igname, are derived from the negroes. In the negro dialect of Guinea, the word "yam" means to eat.

The want of a Sanscrit name for this plant in Northern India clearly shows that it is not indigenous there. The other species of *Dioscorea*, cultivated more or less on the islands of the Indian archipelago and the continent, are *Dioscorea pentaphylla*, L., *D. bulbifera*, L., *D. aculeata*, L., and *D. deltoides*, Wall, (*D. sativa*, L.). All of these have their native home in the Indian Archipelago and in India itself, and are nowhere met growing wild.

The tubers of the Tacca (*Tacca pinnatifida*, L.), furnish a mealy nutriment to the inhabitants of the Society Islands and the Moluccas, where the plant is met with both wild and in a state of cultivation.

In the latter case, the tuberous root loses something of its original acridity and bitterness. The same is the case with the sharp tubers of *Dracontium polyphyllum*, L., which is also used upon the Friendly Islands for want of other kinds of food.

The tuberous root of the Tupinambur or Jerusalem artichoke (*Helianthus tuberosus*, L.), is of less importance. America is its native country, although it is still doubtful from what point it is derived. The name under which it was first cultivated in Europe, at the beginning of the seventeenth century, (*Aster peruvianus tuberosus*), furnishes a clue to its probable birth-place, which is strengthened by the fact that three other species of *Helianthus* are peculiar to the chain of the Andes. The Tupinambur is chiefly cultivated in the United States of North America, and is very little used in Europe.

The tubers of the *Oca* or *Oxalis tuberosa*, Mol., furnish a scanty substitute for more generous means of nutriment. The oca is cultivated in the Andes, from Chile to Mexico, and reaches a height of 8,000 feet. Its tubers vary from the size of peas to that of nuts, and of no very pleasant taste. The same is the case with the *Oxalis crassicaulis*, Zucc. (*O. crenata*, Jacq.), which is indigenous to Mexico, Peru, and Colombia, as also with the *Oxalis tetraphylla*, Cavan., and *O. esculenta*, Hort. Berol.

It is very probable that the *Oxalis enneaphylla*, Cav., indigenous to the Malouine and Falkland Islands, as well as *Oxalis violacea*, L., of Carolina, are not much better articles of food. In the same category may be included the tuberous root of the *Tropæolum tuberosum*, Don.

The *Ulluco* or *Melloco* (*Ullucus tuberosus*, Loz.), a juicy plant with creeping stem, the sprouts of which swell at the tips into tubers from the size of a hazel nut to that of a pigeon's egg, like the sweet potato, is also a native of the Andes of Bolivia, Peru, and New Granada. These tubers are of an insipid taste, although improved by freezing. They are still cultivated at a height of 11,000 to 13,000 feet in Popayan and Pasto, (Peru,) under the name of *Oca quina*. During the period of the potato disease in Europe, an attempt was made to replace this tuber by the oca, but without satisfactory results.

There is a tuberous root of *Apios tuberosa*, Mönch, (*Glycine apios*, L.), found in northern America, (Canada, Virginia,) which is somewhat similar to the Jerusalem artichoke. These taste like the artichoke, and like them are eaten as food and their seeds applied to the same purpose. The mealy root of *Lupinus littoralis*, Douglas, is used in a similar manner on the northwest coast.

A third leguminous plant, the potato-bean, (*Stizolobium tuberosum*, Spgl., *Dolichos tuberosus*, Lam.), found on the Antilles, is remarkable for tubers the size of a child's head. A fourth kind, the turnip-bean, (*Pachyrhyzus angulatus*, Rich., *Dolichos bulbosus*, L.), found in the Philippines and Moluccas, has a root tasting like the turnip. The seeds of the former also serve as food; the latter is known in the whole of tropical Asia.

I may here mention bulbs of two species of crocus. That of the *Crocus vernus*, L., or spring crocus, is of little importance, as it is only eaten by children; but the much larger bulb of the *Crocus edulis*,

Boiss., is brought to market in Damascus at the time when the bulb is about sprouting, and is there very much prized as a vegetable. (Th. Kotschy.)

We may here mention also the tubers of the Arrow-head (*Sagittaria sagittifolia*, L.), and the creeping root of *Nelumbium speciosum*, W., which in China, and the latter in Japan and tropical Asia, are frequently used as food. The stalks of *Nelumbium*, according to C. Von Hügel, are not dissimilar in taste to our broad beet, with a somewhat sharp after-taste.

It is a well-known fact that the mealy rhizoma of *Nymphaea lotus*, L., (the Egyptian lotus,) and probably also that of *Nymphaea coerulea*, L., served the inhabitants of Egypt for nutriment in the oldest times as well as in the present day. The same is the case also in the East Indies with the *Nymphaea edulis*, D. C., and in China with *Euryale ferox*, Salisb.

A few plants are distinguished by the presence of jelly, or by a starch-like condition of their cellular substance, among which are various species of Algae, or sea-weeds, and Lichens. From both these great groups of plants mankind, driven by necessity, has been able to derive nutritious substances from materials sometimes more or less unpalatable.

Among the Algae most common and frequently used as food, are *Ulva lactuca*, Lin.; *Iridaea edulis*, Bory, (*Halymenia edulis*, Aghd.); *Laurentia pinnatifida*, Lamour., (*Pepper dulce* of the Scotch); *Rhodomenia palmata*, Grev. (*Halymenia palmata*, Ag.); *Rhodomenia ciliata*, Grev. (*Sphoerococcus ciliatus*, Agh.); *Laminaria saccharina*, Lam., the Sugar tang; *Laminaria digitata*, Lam., &c.; all used on the coasts of Ireland, Scotland, and Northern Europe; partly raw and partly prepared. Here, also, belong the *Alaria esculenta*, Grev., and the *Porphyra purpurea*, Agdh., which, under the name of *Laver*, appears on the tables of the English as a choice dish. The starch tang or Ceylon Moss (*Plocaria lichenoides*, J. Ag., *Sphaerococcus lichenoides*, Ag.), is also used as food, either in its natural condition or as a constituent of the Indian bird's nests.

Among the Lichens, the Manna stalk (*Parmelia esculenta*, Ledeb., *Lecanora esculenta*, Spr.), occupies the first place; it grows chiefly upon the Tartarian and Kirgese steppes of Tartary in great numbers, upon dead, loamy soil, and unfrequented rocky cliffs, loosely attached and consequently easily separated. When it is collected in hollows, or perhaps carried a considerable distance by high winds, it produces the remarkable phenomenon of showers of manna rain; all which has been observed at different points quite recently, and at various times, in Asia Minor and in Persia.

This lichen, which occurs usually in pieces the size of a hazel-nut, is distinguished by having about 23 per cent. of jelly, some inulin, and a large proportion (about 66 per cent.) of chlorate of lime. Ground up and baked as bread, it more or less satisfies the appetite. It is not improbable that the manna of the Israelites was, not as Ehrenburg believed, the expressed and hardened juice of the Tamarish (*Tamarix gallica*, L. Var., *mannifera*, Ehrb.), but the manna lichen itself, of whose existence in the regions of Sinai we, however, have no direct information.

A second lichen, used both in medicine and for purposes of nutriment, is the Iceland Moss (*Cetraria islandica*, Ach.), which is distri-

buted over the whole north of Europe and America. By separating its bitter constituents it furnishes a very good article of nourishment in those inhospitable countries, and is sometimes converted into bread.

To the various plants already mentioned we may add the seeds, fruit, and other parts of several plants, which although not so generally distributed, are yet, nevertheless, not only equal to them in nutritious qualities and pleasant taste, but may here and there excel them, such as the Sago-palm, the Mauritius palm, the Chestnut, and similar mealy seeds of several other kinds, as the Oak, the Bread fruit, &c. There are also the various pod fruits, beans, peas, lentels, &c., as also the various eatable fungi or mushroom.

The Sago-palm (*Sagus rumphii*, Willd.), often forms great forests upon the islands of the Indian ocean and Moluccas, and is there easily propagated by its suckers. The white inner part of the stem, thickly permeated by bundles of fibers, abounds in a marrowy substance, which, when baked into bread, furnishes a daily food to the inhabitants of most of the southern and southeastern parts of Asia. This, in the form of flour and of granules, is widely distributed in commerce as sago. One trunk of the age of 15 years, will furnish sometimes 600 pounds of sago. A similar use is made in the same country of the mealy *sago-palm*, (*Sagus farinifera*, Lam.) Here, also, we may mention the Mauritius palm (*Mauritia flexuosa*, L., jr.), which on account of its pithy stem, which contains a sago-like meal before flowering, is also called the sago-palm—Sago-palm of South America. It grows from the mouth of the Orinoko to the Amazon, through the whole of Guiana, in Surinam, and throughout northern Brazil, and even in Central America. Its red, scaly fruit tastes like ripe apples; and the mealy pith serves the Indians of these countries as a chief article of food. Even *Caryota urens*, L., *Corypha umbraculifera* L., and *rotundifolia*, L., *Phoenix farinifera*, Roxb., *Borassus flabelliformis*, L., *Arenga saccharifera*, Lab., *Elate sylvestris*, L., *Sagus*, *raphia*, Poir., *Sagus laevis*, Reinw., *Dracaena terminalis*, Jacq., *Cycas circinalis*, L., *C. inermis*, Lour., and *C. revoluta*, Thun., as also *Diodon edule*, Lindl., furnish more or less sago. We may also mention *Puya bonplandiana*, Schult., the Achupalla of the hilly mountains of Peru and Popayan, in whose stems is found a very nutritious pith.

The seeds of the chestnut (*Castanea vesca*, Gärt.), when roasted or baked, are used in various ways for the preparation of flour and bread, and are of much importance to Southern Europe. From its native regions, (Asia Minor, Armenia, and Persia,) where at an early period it served for the nutriment of the inhabitants,* it was carried to the island of Euböa, and thence very easily to Greece, the Grecian islands, Lower and Upper Italy, the Hesperian peninsula, and even over the Alps, and everywhere has obtained no slight importance as furnishing an article of food. This stately tree forms even now entire forests on the mountains of Piedmont, Lombardy, and Tuscany, as well as of

* Xenophon states, that the children of the Persian nobility were fattened upon chestnuts. It is nevertheless probable that the chestnut is indigenous to the Himalayas, where several species exist.

Greece. In the valleys of the Waldenses, in the Cevennes, and in a great portion of Spain, it furnishes nutriment for the common people.

The Chestnut is the Jupiter's oak (*Διὸς βάλανος*), or the Eubœan nut, and with the edible oak or other eatable species of oak, probably constituted the first food of the original inhabitants of Greece. Cato calls it the Grecian nut. Virgil speaks of it as the Kastanian nut. At a later period, on account of its size and excellence in Sardinia, it was called the Sardinian nut. The largest variety at the present day is called *marron* in Italy.

Charlemagne commended the propagation of the *Castanea* to his subjects. This tree was first brought to England in the beginning of the sixteenth century. This variety of chestnut occurring in North America (*Castanea vesca*, var. *americana*, Michx.) is eaten raw, boiled, or roasted, although not depended upon as an article of food. The *Castanea pumila*, Michx., the chinquapin, of the more southern States, is also eaten there. China has a substitute for our chesnut in the *Castanea chinensis*, Spgl., and Java in the *Castanea argentea*, Blum., and *Castanea tungurrut*, Blume.

Several species of the genus oak (*Quercus*) distributed over the whole earth possess edible fruit, which, although rendered somewhat bitter and astringent by the addition of bitter extracts and tannic acid, may yet, when reduced to meal and roasted, be considered as not disagreeable. The fruits of several kinds of oak, however, are actually sweet, and taste like chestnuts. Among these are *Quercus esculus*, L., *Quercus ballota*, Desf., *Quercus persica*, Jaub. and Spach.

That the first inhabitants of entire Greece, not merely of Arcadia, must have derived their subsistence from acorns, before Demeter or Ceres arrived upon the field of Eleusis with her sheaves, is intelligible in itself, as well as that it may have been principally the most widely distributed *Quercus ballota* and *Quercus aegilops* that furnished them their nutriment. The *φηγός*, *Quercus aegilops*, L., (not *Q. esculus*, L.), was therefore principally held in honor, and we constantly find it adorning the grave of Ilios, the founder of Ilion, as well as the renowned oracle of Dodona. The beautiful custom of the "citizen's crown" is probably connected with the original use of the oak as a food plant. The *Quercus robur*, W., and *Quercus pedunculata*, W., certainly played the same part in ancient Germany, and, therefore, not without reason, was considered as sacred by the inhabitants.

According to Link there are in the vicinity of Lisbon whole forests of *Quercus ballota*, Desf., (actually indigenous to northern Africa,) which constitute the wealth of the country and nourish a number of men. The acorns are principally used for feeding swine, though they are also eaten by the poorer people.

Besides *Quercus edulis* and *Quercus ballota*, *Quercus pyrami*, Kotschy, and *Quercus persica*, Jaub. and Spach., are also eaten in Southern Europe. According to Th. Kotschy, the former is brought to market in the Bazar of Adana, and the latter serves as a material for bread in Southern Persia, (Laristan).

The *Quercus castanea*, Wild. (*Q. prinos acuminata*, Michx.), peculiar to the Alleghany mountains of the United States, furnishes also a pleasant-tasted fruit to the western hemisphere.

The tropical regions of the whole earth possess several fruits and seeds similar in taste to the chestnut. Among the most important of these may be mentioned *Bombax malabaricum*, D. C. This enormous tree belongs to the East Indies, has sweet and pleasant-tasted seeds, which are used both raw and roasted. The mealy seeds of *Carolinea princeps*, L. fil., indigenous to Guiana, when roasted, likewise taste like chestnuts. The young leaves and flowers, also, are used as a vegetable. The same is the case with *Carolinea insignis*, Swartz, of the Antilles.

The seeds of *Melicocca bijuga*, L., or Honey berry—the fruit of which we will mention hereafter—are roasted, and also taste like chestnuts. The sweet, chestnut-like seeds of *Cupania tomentosa*, Swartz, are also used in the West Indies. The seeds of *Blightia sapida*, König, of Guinea, have also a fine flavor when cooked and roasted with the fleshy arillus. This tree is now cultivated on the Antilles, as is also the case with *Laurus chloroxylon*, Sw., in Brazil, and *Sloanea dentata*, L., in South America. The *pot-tree* (*Lecythis ollaria*, L.), of tropical America, remarkable for its fruit the size of a child's head, is much prized on account of its chestnut-like seeds. There are still other species of *Lecythis* furnishing similar seeds. We may mention, in conclusion, *Castanospermum australe*, Forst., the seeds of which, the size of a chestnut, when separated from the hull, are used at Port Jackson like the chestnut.

The Bread fruit tree (*Artocarpus incisa*, Linn., fil.), has been distributed from the Moluccas, by way of Celebes and New Guinea, throughout all the islands of the Pacific Ocean, to Otaheite, but is nowhere to be met with growing wild. It is also naturalized in the Isle of France and tropical America. In its fruit, which is fit for use without additional preparation, it furnishes one of the most generous means of nutriment which the earth possesses. The rich abundance of the fruit which a single tree supplies throughout the entire year, makes it an inexhaustible source of life, the maintenance of which is the care of every family. Its many varieties, among which are several without seeds, show that its cultivation goes back to the most remote antiquity.

The *Artocarpus integrifolia*, Linn., fil., closely allied to the Bread fruit tree, is more peculiar to the western islands of the Indian archipelago. On account of its excellent fruit it is a special object of cultivation on the two Indian peninsulas, in Cochin China, and Southern China. It has only been recently introduced into the islands of the Pacific Ocean, as well as upon the Island of Mauritius, the Antilles, and the west coast of Africa. It is scarcely to be doubted that it occurs here and there growing wild, and that perhaps Ceylon and the Peninsula of Further India may be looked on as its original native land.

How far removed from those happy lands, where each Bread fruit tree constantly represents a ripening field of grain, are those regions of the earth where the hungering man is obliged to resort to the scanty nutriment of the root-stalk of the ferns, or, as in Iceland, to the root-stalk of the sand-reed (*Arundo arenaria*, L.), and of the Adderswort (*Polygonum bistorta*, L.).

The pod fruits, on account of the mealy character of their seeds,

belong to the series of farinaceous substances. The great abundance of an albuminous material, legumin, which is found in them, in addition to the starch, places the pod fruits upon the same level with the most nutritious cerealia, such as the wheat, &c.

Of all the pod fruits, it is probable that the bean (*Vicia faba*, Linn., *Faba vulgaris*, Mönch.), indigenous to the southwestern banks of the Caspian sea, has been longest known and most widely distributed. Even by the Greeks and Romans it was considered as sacred, and it was cultivated by the Jews. A temple dedicated to the God of Beans, *Kyanetes*, stood upon the sacred road to Eleusis, he having first cultivated beans. The Kyanepsia, or Bean feast, which the Athenians celebrated in honor of Apollo, was characterized by the use of beans. The bean was an impure fruit to the Egyptians, who did not venture to touch it. Pythagoros even forbid his scholars to eat beans. The black speck on the white wings of the flowers was formerly looked upon as the written character of death; for which reason the bean in ancient times passed as the symbol of death. The name *κυαμὸς* came from *κύειν*, as well as the Latin word *Faba*, from *φανειν* (Landerer).

The bean is not found in the catacombs of Egypt, perhaps for the the above-mentioned reason. What the Greeks called "the Egyptian bean" is not this bean, but the seed of the *Nelumbium speciosum*. The bean belongs among the five different kinds of seeds which the Emperor Chin-nong introduced into China in the year 2822 B. C. In Abyssinia bread is baked from the bean. Many varieties have already arisen in its culture.

Of the Lupines which grow wild throughout the whole Mediteranean region, *Lupinus hirsutus*, L., alone was cultivated by the Greeks under the name of *θέρμος*, and serves now in that country as food for cattle and the poorer classes of people, as it did the Cynics. The Mainots make use of it for food at the present day, and bake bread from it, for which reason they are called Lupinophagi. The Hindostan name, *Turmas*, and the Arabian, *Termis*, clearly indicate that this plant has been propagated from Greece to India and Arabia. At the present day it grows wild throughout the whole of the Mediterranean region, from Portugal and Algiers to the Greek islands and Constantinople.

The same is the case with *Lupinus albus*, L., the wolf bean, and *Lupinus termis*, Forsk., (Mediterranean plants); the first distributed throughout Italy, Sicily, and Thrace, to Southern Russia; the latter found in Sardinia, Corsica, Sicily, &c. Both are, at the present day, used almost exclusively as food for cattle. The latter, however, when cooked in salt water, and shelled, are eaten in Egypt. Both are cultivated in Italy, and the wolf's bean has been introduced into the Rhine country since the sixteenth century. The New World (in *Lupinus perennis*, L.,) has also its wolf's bean, and its bitter seeds are eaten from Canada to Florida.

The lentil (*Ervum lens*, L., *φαχός* Diosc, and *φαχι* of modern Greece) was known to the Greeks, Jews, and Egyptians, but has been only recently introduced into Bengal. This circumstance, and the fact that India has not cultivated this plant at an earlier period, indicate a more westerly native country, which may be fixed in Northern Caucasus and South Russia, for the reason that the lentil, besides being

cultivated, grows wild, and is also occasionally to be met with, run wild, throughout the whole of Europe.

The lentil of the present day serves the Bedouin for bread-fruit, and a variety (*Ervum lens* var. *abyssinica*, Hochst.) has originated upon the high plains of Abyssinia (5,000 to 8,000 feet.) Besides this one, several other varieties have been formed in the course of time.

The pea (*Pisum sativum*, L., *πισον*, Theoph.), was in estimation as a culture plant even among the Greeks and Romans; in fact, its cultivation even in India goes back to a remote period, as is shown by its Sanscrit name, and the many more modern Indian names. The pea is found growing wild, at the present day, upon the hills of the Isthmus of the Crimea, and its native country was probably originally along the coast of the Black Sea. It was mentioned in the "*Capitulare de Villis*," (*Pisum mauriscum*,) and, at the present day, it has extended in various varieties to Hammerfest and Lapland. A similar distribution is to be assigned to the *Pisum arvense*, L. This species, at the present day, is cultivated more frequently than the preceding in Egypt, and has not remained unknown in India. Besides these, two species of pea may be mentioned—the Egyptian pea (*Pisum jomardi*, Schrank) and the Abyssinian pea (*Pisum abyssinicum*, Alex. Braun)—belonging chiefly to Africa, as also *Pisum maritimum*, L., and *Pisum ochrus*, L.; the former growing wild on the coasts of France, England, and Denmark, as far as Kamtschatka; the latter occurring in Italy, Portugal, Spain, and Crete, but used as an article of food only in times of famine.

The Chick-pea, (*Cicer arietinum*, L., *ἐρέβινθος*, Theoph.), is an important kind of pea to the East. The Jews, Greeks, and Egyptians cultivated it in ancient times, and it was also used as an object of devotion, at an early period, even in India, as is shown by the Sanscrit names. The common class of Greeks even now make use of it, both raw and roasted, during the winter months, and employ it as a substitute for coffee. It is also cultivated frequently, at the present day, in Egypt, as far as Abyssinia, and, according to Th. Kotschy, is one of the most generally distributed of cultivated plants on the heights of Lebanon as well as in Spain.

This plant is represented as almost growing wild in the Caucasian countries, in Greece, &c., and is also found run wild here and there in the fields of Middle Europe.

The Flat-pea (*Latpyrus sativa*, L.), is used more as a fodder-plant in the green condition, than for purposes of food.

Both the bean and the pea, as well as the chick-pea, were introduced into the model farm of Charlemagne; at present, they are distributed over almost the entire earth.

The Kidney bean was not unknown to the ancients; but it is scarcely possible to refer the different kinds to those of the present day. The Greeks cultivated *Phaseolus vulgaris*, L. (*δολιχος*), as well as *Phaseolus nanus* (*φασίολος*); and as these are only sparingly met with in eastern Asia, and as there is no Sanscrit name for them, it is probable that they were derived from Western, rather than from Eastern Asia.

At least a dozen different kinds of bean are cultivated in India, of

which several have their home in Southern China, in Cochin China, &c. There is no species of bean found growing wild at the present day in India.

Of the East Indian species of *Phaseolus* which are an object of cultivation, we may mention first *Phaseolus mungo*, L., the bean of which, with rice, constitutes the principal article of nourishment in the East Indies and in China. It is also cultivated in Egypt and Italy at the present day. A second species, *Phaseolus radiatus*, L., and *Phaseolus lunatus*, L., likewise very palatable, as also *Ph. tunkinensis*, Lour., of Cochin China; *Ph. max*, Roxb.; *Ph. calcaratus*, Roxb. of Mysor; *Ph. aureus*, Roxb. of Bengal; *Ph. torosus*, Roxb. of Nepal; and *Ph. aconitifolius*. The last is mostly used for feeding domestic animals.

Certain American species correspond to the Asiatic just mentioned; such as *Phaseolus coccineus*, Lam. (*Ph. multiflorus*, Willd.), *Phaseolus derasus*, Schrank, from South America, and *Phaseolus farinosus*, L. and *Phaseolus lathyroides*, L. from the West Indies. The former at the present day is even cultivated in Europe.

The genera *Dolichos* and *Lablab* may be mentioned next to *Phaseolus*, the former belonging chiefly to the New, the latter to the Old World.

The cultivated species of these are *Dolichos sesquipedalis*, L., from tropical America, *Dolichos glycinoides*, Kunth, of Peru and Chile, *Dolichos melanophthalmus*, D. C., the native land of which is unknown, and is now cultivated in Europe. *Dolichos sphaerospermus*, D. C., comes from Jamaica. *Dolichos unguiculatus*, Jacq., from Barbadoes.

The species of the Old World are *Dolichos sinensis*, L., indigenous to the East Indies, China, and Cochin China. *Dolichos catiang*, L., of the East Indies, and actually cultivated in Portugal and Italy. *Dolichos niloticus*, Delil. (*D. Sinensis*, Forsk.), and *Dolichos lubia*, L., of Egypt. Of the genus Lablab we may mention *Lablab vulgaris*, Sav. (*Dolichos lablab*, L.), introduced from Egypt to the East Indies, *Lablab nankinensis*, Sav., *Lablab leucocarpus*, Sav., *Lablab microcarpus*, D. C., *Lablab perennis*, D. C. Of all these, both the ripe seeds and the unripe fruit are used. *Soja hispida*, Monch. (*Soja japonica*, Sav.), or Soy, from Japan, is cultivated in Southern Asia and Europe.

What the previously mentioned legumens are to the colder portions of the earth the Ground nut (*Arachis hypogaea*, L.) is to the warmer zone. This plant was known neither to the ancient Egyptians and Arabians nor to the Greeks. The latter certainly did not understand this plant under the name of *αραχος*, which was probably a species of *Vicia*. It has been cultivated a long time on the west and east coast of Africa, and only quite recently introduced into the Mediterranean regions. A Hindostan name alone exists for it in Asia. In modern times only, it has been cultivated generally in China and Cochin China, which countries it has reached in some unknown way. On the other hand, six species of *Arachis* certainly belong to the *Flora* of Brazil, and the older authors also mention the cultivation of *Arachis hypogaea* under the name of *Mandubi*, *Anchic*, and *Mani*, on which account there is little reason to doubt its American origin. The thick tuberous seeds are frequently eaten raw, but are very palatable when roasted. The oil from it is excellent, and is much esteemed in India.

As I find no more convenient place for introducing those plants, which

on account of their nitrogenous constituents are particularly nutritious, although somewhat difficult of digestion, I bring them in at the end of the leguminous ones. I refer to the *fungi*, several of which, by proper preparation, surpass all other vegetable substance in palatability. Here, above all others, we may mention the Truffle, (*Tuber cibarium*, Pers.), a much praised subterranean fungus, varying from the size of a nut to that of the fist, and occurring chiefly in chestnut forests of Southern Europe, it was known even to the ancients (ὕδνον, Diosc.) To these may be added other species of truffle, such as *Tuber album*, Bull., and *Tuber griseum*, Pers., in Upper Italy, *Tuber moschatum*, Bull., in France, *Tuber niveum*, Desf., in Barbary, and one occurring in the Arabian deserts, of which Olivier makes mention. Of less importance are certain morel fungi, such as *Clavaria coralloides*, Bull., *Cl. botrytis*, Pers., *Cl. stricta*, Pers., *Cl. cinerea*, Bull., *Cl. rubella*, Schäff., *Cl. amethystea*, Bull., &c.; also *Helvella esculenta*, Pers., *H. monachella*, Frs., *H. crispa*, Frs., *H. ramosa*, Schäff., *H. elastica*, Bull., *H. infula*, Schäff., *H. mitra*, L., *Morchella esculenta*, Pers., *M. conica*, Pers., *M. bohemica*, Kromb, and *M. deliciossa*, Frs., *Hydnum repandum*, L., and some other species occurring abundantly in the European forests furnish only an unpalatable nutriment.

The *genera Boletus* and *Agaricus* are rich in esculent species. The most important of these are: the *Herrenplz* (*Boletus edulis*, Bull.), the *Kaiserling* (*Agaricus cæsarius*, Schäff.), the common mushroom (*Ag. campestris*, L.), the *mousseron* (*Ag. mouceron*, Bull., *Ag. albellus*, Schäff.), the honey dove (*Ag. russula*, Schäff.), the *Reizger* (*Ag. deliciosus*, L.); as, also, *Agaricus palomet*, Thore (*Ag. virens*, Scop.), and the *Agaricus aurantiacus*, known to the Romans under the name *Boletus*, and always occurring in the chestnut forests of Southern Europe. It is this species which Nero called "*cibus desrum*," food of the gods.

Of less importance, although frequently used as food, are *Agaricus procerus*, Scop., *Ag. alutaceus*, Pers., *Ag. sapidus*, Poir., *Ag. esculentus*, Pers., *Ag. aureus*, Pers., *Ag. virescens*, Pers., *Ag. amethysteus*, Bull., *Ag. anisatus*, Pers., *Ag. tigrinus*, Bull., *Ag. infundibuliformis*, Bull., *Ag. nebularis*, Batsch., *Ag. aromaticus*, Roques, *Ag. tortilis*, Bull., *Ag. violaceus*, L., *Ag. hæmatochelis*, Bull., *Ag. ostreatus*, Pers., *Ag. subdulcis*, Pers., *Ag. lactifluus aureus*, Pers., *Ag. virgineus*, Jacq., *Ag. eburneus*, Bull., *Ag. auricula*, Dub., *Ag. eryngii*, D. C., *Ag. ovinus*, Bull., *Ag. aquifolii*, Pers., *Ag. ilicinus*, D. C., *Ag. virgineus*, Batsch., *Ag. frumentaceus*, Bull., *Ag. castaneus*, Bull., *Ag. cortinellus*, D. C., *Ag. caudicinus*, Pers., *Ag. sambucinus*, Cord., *Ag. attenuatus*, D. C., *Ag. rubescens*, Corda, *Ag. solitarius*, Bull., *Ag. ovoideus*, D. C., *Ag. leiocephalus*, D. C., *Ag. vaginatus*, Bull., *Ag. incarnatus*, Pers.; as, also, *Boleius æreus*, Bull., preferred by many to the mushroom, *B. scaber*, Bull., *B. aurantiacus*, Bull, *B. hepaticus*, D. C., *B. carinthiacus*, Jacq., and *Polyporus ovinus*, Schäff. We may mention, in conclusion, the egg-sponge, or Pfiffering (*Cantharellus cibarius*, Frs.) Besides these fungi belonging particularly to Europe, there are other regions of the world which are not without palatable representatives of this branch of the vegetable kingdom. Among these, I may mention a few, such as *Boletus moschocaryanus*, Rumph, Herb. Amb., 6, 9, 19; *B. saguarius*, Rumph, and *Polygaster sampadarius*, Frs.; the

former eaten as a delicacy on the Banda Islands, and the latter in Amboyna.

In the southern States of North America, upon soil recently cleared of timber, is found the Indian potato, or Indian bread (Tuckahoe), the gigantic *Lycoperdon* (*Pachyma*) *solidum*, Gronov., which attains a weight of from 15 to 30 pounds, and was formerly eaten by the Indians. It sometimes furnishes the entire food of runaway negroes.

All these fungi, with the exception of a few, belong to Europe. Only a few, as for example the true mushroon, or *champignon*, the truffle, &c., are cultivated, and thus developed into varieties. The edible fungi may be kept, when dried, for a long period of time.

There is an extensive group of nutritious plants, the seeds, fruit, and even tubers of which are characterized by a great abundance of fatty oil. The oil in these is generally mixed with starch, gum, sugar, and albuminous substances, and forms a kind of emulsion.

The almond, the walnut, the hazel-nut, the oil-palm, the Brazilian nut, and the nut of *Acromia sclerocarpa* and *Attalea compta*, the pistici, the olive, the water-nut, the seeds of *Nelumbium*, &c., as also the earth almond, and several other species, belong to this category.

The almond tree (*Amygdalus communis*, L., *ἀμυγδαλῆ*, Theoph.), with a thick and hard, or thin and soft, shell to its kernel, like many other species of the genus, is indigenous to Western Asia and North Africa; although, at the present day, it is hardly met with there in a wild condition. It was known at a very early period to the inhabitants of the Mediterranean regions of Syria and Palestine. The Jews make mention of it; and it was carried by the Phœnicians to the Hesperian peninsula (towards Lusitania and the Baetican province). It was sacred to Cybele, in Greece, where, even at that time, there were two kinds there, with sweet and with bitter nuts. Phyllis hangs herself on an almond tree, and is transfigured into it. Cato called it *nux Græca*, from which it by no means follows that at that time it was not propagated in Italy. Charlemagne caused *amandalarios* to be planted on his estate. At the present time it is distributed over the whole of Southern Europe, throughout Persia, Arabia, China, and Java. In addition to the common almond, the seeds of *Amydalis orientalis*, Oliv., *Amygdalis scoparia*, Jaub., *Amygdalis arabica*, Oliv., and *Amygdalis agrestis*, Boiss., are eaten at the present day in Eastern and Southern Persia, and constitute an article of trade in the bazaar.

The walnut (*Juglans regia*, L.), characterized by its oily and yet pleasant-tasted kernel, is referred to by Theophrastus under the name of *κάρυον*, and various popular customs in ancient Greece have reference to this nut. The name *περσικά* relates to the region whence it was derived, and it is quite possible that Alexander the Great may have brought it from Persia, where it was earliest cultivated.

The Romans received their *Jovis glans* (*Juglans*) as early as the time of the kings. The walnut, although distributed from Lebanon throughout all the mountain region eastward to Shiras, occurs generally as a single tree, and never forms plantations. It likewise occurs single in southern and middle Europe, ascending in our Alpine valleys to a height of two thousand five hundred feet. Ledebour states that the walnut grows wild in Southern Caucasus; others refer it to the

mountain valleys of Talysch, where it occurs wild, and the same is stated of Persia and Cashmere. The walnut tree by cultivation passes into various varieties, and is occasionally cultivated more on account of its excellent timber than on account of its fruit.

There are various edible species of walnuts and of allied hickory-nuts in North America, especially *Juglans nigra*, L. (Black walnut), *Juglans cinerea*, L. (Butternut), *Juglans fraxinifolia*, Lam., and *Carya olivæformis*, Nutt., (Pecan nut), with other kinds of *Carya*, the seeds of which are used partly raw for the table, and partly in the preparation of oil. This is the case also with the *Juglans baccata*, L., indigenous to Jamaica, excepting that its seeds are more fitted for furnishing meal, on account of their richness in starch.

The oily seeds of the Cacao, or chocolate, (*Theobroma cacao*, L.), possess an agreeable aromatic taste, and are chiefly used for the preparation of various drinks. The cacao grows wild in the river districts of the Amazon and Orinoco, whence it has been distributed to other parts of Middle America, (Mexico and the Antilles), where its cultivation forms a very important branch of trade in the warm and moist regions. Other species, such as *Theobroma bicolor*, H. B., *Th. speciosa*, Willd., *Th. sylvestris*, Mart., and *Th. guyanensis*, Willd., replace the cacao in the West Indies and South America, and like the latter are introduced into commerce.

There are various species of Hazel nut (*Corylus*), the oily nuts of which are used as food. The principal of these are the common hazel nut, *Noisette*, or filbert (*Corylus avellana*, L.), which is distributed over the whole of Europe and Northern Asia: the Lombardy or Lambert's nut (*Corylus tubulosa*, Willd.), of Southern Europe, and the Turkish Hazel nut (*Corylus colurna*, L.) The latter is a stately tree, forming whole forests in its native land, (Pontus), from which it was carried, from the Island of Thasus, to Macedonia and Thrace, and has been distributed to Pannonia and throughout the whole of Italy. It was brought to Germany in the sixteenth century by Valerius Cordus, who received it from the Hungarian embassador in Constantinople. The citizens of Avellum, in Campania, could not have cultivated the common hazel nut, but the Turkish species.

The common hazel nut has already developed six varieties by cultivation. *Corylus glomerata*, Nois., is only a variety of *Corylus colurna*, L., with large early fruit.

Corylus rostrata, Ait., and *Corylus americana*, Michx., which grow wild in North America, from Canada to Florida, furnish an excellent fruit, commonly known as hazel nuts.

Some other plants, the seeds and fruits of which are quite similar to those we have just mentioned, are *Guevina avellana*, Molina, (*Quadria heterophylla*, Pav.), the Chilian hazel nut; *Cavanillesia platanifolia*, Kunth, in Colombia; *Pourretia tuberculata*, Mart., in Brazil; *Anacardium occidentale*, L., (the Cashew nut); *Omphalea triandria*, Aubl., and *Omphalea diandira*, Aubl., in the West Indies. Also *Siphonia elastica*, Pers., *Aleurites moluccana*, Willd., *Cervantesia tomentosa*, Ruiz and Pav., in Peru; *Hamiltonia oleifera*, Willd., (Oil nut), in North America; *Pangium edule*, Reinw., in the Indian archipelago; *Hamamelis virginica*, L., the Witch hazel, and *Hamamelis*

macrophylla, Pursh.; *Hamamelis parvifolia*, Nuttall, of North America; *Canarium commune*, L., in Java; *Myrobalanus bellerica*, Gärtn., in the East Indies; also the forest almond of St. Domingo, *Hippocratea comosa*, Swartz, and the fruit of the *Quercus virens*, Ait., or American live oak, from which the wild tribes prepare an oil, in North America.

The seeds of *Cicoia guyanensis*, Aubl., *Parinarium montanum* and *P. campestre*, Aubl., from Guinea, and *Parinarium senegalense*, Poir., from middle Africa, *Licania incana*, Aubl., and *Bombax ceiba*, L., from South America, have much resemblance in taste to almonds.

The Brazilian nuts, or *Juvias*, come from a magnificent tree (*Bertholletia excelsa*, Humb. and Bonpl.) which has an extended distribution in the forests of Guyana and Brazil, particularly between the river district of the Orinoco and Rio Negro. The angular brown seeds of this tree, the size of a walnut, have an oily kernel, and taste like almonds. They soon become rancid and must be eaten fresh. Many tribes of Indians live for a long time upon these seeds, which they collect and harvest with great rejoicing.

The seeds of *Caryocar amygdaliferum*, Cav., and *C. butyrosum*, Willd., called *Pequi* and *Souari* in their native region, furnish nutriment similar to almonds, on account of their oily nature. The former is a high tree in Ecuador and Santa Fe de Bogota; the latter in Guyana. We may also mention *Caryocar glabrum*, Pers., and *Caryocar tomentosum*, W., in Guyana, and *Caryocar nuciferum* on the Essequibo.

Among the palms furnishing oil may be mentioned particularly the oil palm (*Elais guineensis*, L.), belonging to Congo, and the entire tropical region of Africa, and distributed thence to Brazil. From the hulls of the fruit of this tree most of the palm oil of commerce is expressed. There are also the *Acromia sclerocarpa*, Mart., and *Attalea compta*, Mart., the *Alfonsia oleifera*, H. B., in South America, also the king of palms, the cocos palm, or cocoa-nut tree, (*Cocos nucifera*, L., and *Cocos butyracea*, Linn, jr.) This beautiful tree, which at the present time is distributed over all the coasts and islands of the tropics, namely, the islands of the South sea, of the Indian Archipelago, East and West Indies, Brazil, Africa, &c., and which seems to have mainly propagated itself, has nevertheless proceeded from a very limited locality. The large size of the fruit, the ease with which it is transported by means of oceanic currents, and the influence of salt water as a condition of germination, are sufficient to render a great distribution possible. The original native land of this useful tree seems to be the Cocos islands west of Panama and the coast of Central America; from which region its distribution has taken place from a far remote period by means of the equatorial current to the small islands of Duncan and Galega, and thence to the different groups of islands of the Pacific ocean.

When the embryo is unformed the fruit furnishes sweet palm milk; a further development supplies a white, sweet, and aromatic kernel, which tastes much better than almonds. And it finally becomes still firmer, and then possesses a pleasant, sweet oil.

The oily *pistacio* nut (*Pistacia vera*, Lin.), and the *Terebinth pistacio* (*Pistacia terebinthus*, L.), are of less moment and more limited distribution. The former is obtained from a tree originally indigenous to Persia, Bactria, and Syria, but cultivated in the Mediterranean regions.

The latter comes from a very large and stout tree of the Mediterranean flora. Boissier has distinguished the former, which occurs in Palestine and Syria as a distinct species, (*Pistacia palaestina.*) The genuine pistacio furnishes a pleasant food, which was liked by the ancient Parses, for which reason this beautiful tree is frequently cultivated, while the fruit of the terebinth (τερέβινθος, Theoph.) is scarcely edible on account of its resinous taste. The tree of the Palestine terebinth, which often attains a circumference of 10 to 12 feet, is of importance in other respects, since it stands in the most intimate relationship to the theocracy of the Jews. The terebinths of Mamre, of Ophra, Jabez, and Sichem, have a historical renown.

Here may be mentioned the seeds of some coniferous trees, as those of *Taxus nucifera*, and *Salisburia adantifolia*, Sm., in Japan, and the stone pine (*Pinus pinea*, L.), the Siberia pine (*Pinus cembra*, L.), the cone of the pine of Norfolk island (*Araucaria excelsa*, R. Brown), and the American Araucaria (*Araucaria imbricata*, Pav.) The latter is a tree which furnishes to the Indians of Patagonia a great portion of their nutriment. It grows from the twenty-seventh to the forty-eighth degree south latitude—never in the low lands. It furnishes to the nomadic races (Araucarians) the necessary vegetable nutriment, who depend upon it the more exclusively in proportion to their distance from the whites, and the greater or less difficulty of obtaining the ordinary cerealia by means of trade. The nut is shaped like an almond, but twice as large. A single cone will have from 200 to 3[illegible] nuts, and will furnish a days' food to an Indian with the addition of little meat. The oily seed is nevertheless not very digestible, and cannot be kept any length of time, as it soon becomes of a stony hardness. The natives, however, prepare from it a dish, which keeps a long time.* The Catappa tree (*Terminalia catappa*, L.), furnishes a pleasant-tasted, edible kernel. This grows on many islands of the Indian Archipelago, especially on the Moluccas. The fruit is similar to the walnut, and has from one to two almond-like kernels. It is now cultivated in the Antilles. Similar fruits are furnished by the *Terminalia moluccana*, Lam., *Terminalia glabrata*, Forst., in the Society and Friendly Islands, *Terminalia mauriciana*, Lam., on the Mascarenhas and *Terminalia latifolia*, Swartz, in South America. Besides these, the kernels of the fruit of *Incarpus edulis*, Fort., *Sterculia balanghas*, L., and *St. fœtida*, L., are eaten by the islanders of the South Seas generally.

The unripe seeds of various palms furnish oily kernels, as *Cocus arenaria*, Gomez.

The Olive tree (*Olea europæa*, L.) is incontestibly the most important oil-producing plant. Homer† mentions green olives in the garden of Alcinous and Laërtes, which were brought by Cecrops, the founder of Athens, to Greece. Minerva planted it with her own hand upon the consecrated locality of her citadel, by thrusting her spear into the ground. No temple or sacred place dedicated to her is without its olive tree. As light is kept up by means of oil, so this has become an indication of the divine peace and of earthly blessings. Jehovah

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* Pöppig, Reise, i, p. 401. † Odyss. vii, 112.

himself announced his reconciliation with earth by means of an olive branch. The olive belongs to the fruits which were promised to the Jews in Canaan. This tree was first brought to Italy in the year 571 before Christ, and at the time of Pliny had been carried over the Alps to Gaul and Spain. At the time of Cato, the Romans were acquainted with only nine kinds of olives, which, however, at the time of Pliny, had increased by cultivation to twelve, and, at the present moment, even to twenty. The cultivated olive tree (ἐλαία ἥμερα, Diosc.), was distinguished from the wild olive (ἔγρια ἀλαία, Diosc.) Willkom* is of opinion that the olive tree is indigenous in various parts of the Mediterranean region, Spain, and also in the southern portions of the Peninsula. He states that the olive forest of forty square miles at the foot of the Sierra Morena, to the south, between Andujar and Cordova, may have been entirely planted by hand. He is also of opinion that the olive forest, three leagues in length, situated further south, between Seville and Utrera, to the left of the Guadalquivir, consists of olive trees run wild, having small globular fruit possessing but little oil. He thinks that this forest could only have sprung up in consequence of the driving away of the Moors, or from the neglect of former olive plantations, as has been the case in other instances. He thinks himself, however, safe in stating that the hedges and forests of olives in the southern part of Spain may have arisen from indigenous plants. "The wild olive tree forms forests and groves, not only in the plains of Seville, where it has certainly arisen from the running wild of originally cultivated olive trees, but in the mountains also, as in the Serrania da Ronda, &c. It is most frequently met with in wild sandstone mountains, rising to a height of 4,000 feet along the Straits of Gibraltar, between Algesiras and Alcalá de los Gázules, where, from 2,000 feet and upwards, it forms a principal constituent of the indescribably magnificent foliage which covers that mountain.

"This office is also shared by *Quercus suber*, L., or Cork oak, and *Quercus lusitanica*, Lam., var. *baetica*, Webb. On account of the extraordinary wildness of these mountains, it is entirely out of the question that any cultivation could ever have taken place there. Whence, also, could the massive wild olive trees come which occur in the upper part of the mountains, for in the lower part the forest consists simply of cork oaks? This fact seems to me to speak very loudly in favor of the supposition that the olive tree has been indigenous to Spain from the beginning."

Hence it follows that we must consider the entire coast of the Mediterranean, North Africa to the Canary Islands, Palestine, Syria, Asia Minor, and Greece, as the native land of the olive. On the other hand, however, it is to be borne in mind that the name of this plant has been referred among all nations to the Grecian name ἐλαία, and the Hebrew *zait* or *sait*, which renders it probable that the olive tree was probably distributed by these two nations of antiquity from one point, in two lines, which met again in the Iberian peninsula.

At the present time the olive is distributed not only over all the lands of the Mediterranean, still forming an important source of the riches of many of them, as it was at one time the chief possession of

* Linnæa, 1854, page 702.

Attica and Palestine, but it has also even transcended these limits. The olive oil, next to the cerealia, is the most indispensable necessary of life to the Italian.

The water nuts, or fruit of the water plants, (*Trapa,*) which occur in lakes in Europe and Asia, are distinguished for an abundance of starch and fatty oil; although not very pleasant tasted, they are still gathered in large quantities, and used as an article of food, raw or roasted, and even ground into meal.

There are only two species of *Trapa* which here require special mention, namely: the one indigenous to India, especially to Cashmere, the *Singhara* or *Trapa bispinosa*, Roxb., and the one occurring in enormous quantity in the lakes of China, *Trapa bicornis*, Lin.; the first is fished out of Wuller lake during the winter months, and the inhabitants then obtain a harvest of such abundance that they live on it for the entire year. It is also eaten in Lahore. The second species, *Trapa bicornis*, L., called *Ling* in China, is extensively disseminated in the southern regions of the Celestial empire, and furnishes a staple article of nutriment to the poorer classes of the people. This is fished out in a similar way. It has run into several varieties. *Trapa cochinchinensis*, Lour., and *Trapa quadrispinosa*, Roxb., are of less value. Even the European *Trapa natans*, L., is everywhere made use of, and Pliny states that the Thracians baked bread from it.

The seeds of *Nelumbium speciosum*, Willd., are used for food in India as well as those of *Nelumbium luteum*, Willd., (the yellow-water lily), and *Nelumbium codophyllum*, Rafin., in North America.

The earth almond, or chufa, (*Cyperus esculentus*, L.,) which is found in Southern Europe (South Spain and France) and North Africa, is also deserving of mention. Its tubers of a sweet and pleasant taste contain a mild fatty oil, similar in taste to nut oil, and, like the potato, have twelve per cent. of starch, for which reason they can not only be used as food, but also in the preparation of oil. It was employed at the end of the preceding century as a substitute for coffee in the whole of Germany. The separation of oil from the earth almond is too laborious and expensive an undertaking, and, in more recent times, has been supplanted by many of the so-called oil plants, such as the *Kohlraps* or Colza (*Brassica campestris oleifera*, DC., *Colza*, Lam.*), (*Brassica rapa oleifera*, DC., *La navette*, Lam.), the China oil radish (*Raphanus sativus chinensis oleiferus*, H.), the flax† (*Linum usitatissimum*, L.), the poppy (*Papaver somniferum*, L.), the sunflower (*Helianthus annuus,*‡ L.), the oil Madia (*Madia sativa*, Mollin‖), the Sesame (*Sesamum orientale*, L.§), the Leindotter (*Camelina sativa*, Cranz. ¶), the Nuk (*Guizotia oleifera*, DC.), the hemp** (*Cannabis sativa*, L., and *Hibiscus canabinus*, L.)

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* Growing wild from the Baltic Sea to the Caucasus. Its culture started from Belgium, and is more extensively prosecuted in Holstein

† Wild in Mingrelia.

‡ Indigenous to Mexico and Peru.

‖ Brought from South America, where it was cultivated a long time.

§ A common oil plant in Persia, which was used in the time of Xenophon by the soldiers to anoint their limbs to preserve themselves from being frost-bitten. At the present day it is cultivated in Abyssinia as an oil plant.

¶ Indigenous to Central Europe. and found on the Caucasus and in Siberia; it first became a cultivated plant in the mediæval ages in Germany and Russia.

** Allied to *Helianthus*, and cultivated in Abyssinia.

There is a fitness in treating of the plants yielding sugar after those containing starch, on account of the fact that a majority of them contain a mixture of starch and sugar. The principal representative of the saccharine plants is the sugar-cane, of which there are three species and several varieties, all indigenous to tropical Asia, whence they have been distributed over the tropical regions of the whole world. At the present time the plant is not found growing wild in any locality. The common sugar-cane (*Saccharum officinarum*, L.) is indigenous to India, (Bengal,) and has been cultivated there from time immemorial. This is shown by the Sanscrit name *Sarkura*, from which are derived the Arabic name *Sukkar*, the Grecian *σαχχαρ*, and the modern European names *Zucker*, *Sucre*, *Sugar*, &c. The second species *Saccharum chinense*, Roxb., is undoubtedly a plant peculiar to China, and has been cultivated there independently, and perhaps still earlier than the Indian sugar-cane. Theophrastes called sugar a sweet salt which is produced from a tubular plant. It was still very rare in the time of Dioscorides and Galen.

In the ninth century the Arabians obtained sugar from the sugar-cane, which at that time was cultivated in Susiana, as shown by the mill-stones used in crushing the cane which are found at the present day upon the hills of Ahwaz, on the Kûren river. Sugar was brought from Alexandria to Venice in the year 996. Ten thousand pounds of sugar were used at the wedding of the Caliph Mostadi Bemvillah, (1087.) The sugar-cane is actually a food plant, since it is chewed and sucked, and perhaps eaten; this is still the case in Egypt, in many parts of Asia, on the Phillipine and South Sea Islands. During the frequent droughts it serves as a means of assuaging thirst among the inhabitants of eastern islands.

The sugar-cane flourishes best at a temperature of from 24° to 25° centigrade (73° to 75° Fahrenheit), though it may be raised at a temperature from 19° to 20° (66° to 68° Fahrenheit). In China the cultivation of the Sugar-cane extends to the thirtieth degree of north latitude, in North America to the thirty-second degree. The Jews were unacquainted with sugar, as was also the case with the ancient Babylonians. The cultivation of the sugar-cane was first extended to South Persia and Arabia, and thence to Egypt, Sicily, and South Spain. It reached the Mediterranean in 1420, and at a later period the Canary Islands. Columbus carried it on his first voyage (1490) from the Canary Islands to San Domingo. Captain Bligh took a variety from the South Seas (*Canna d'Otaheite*) to Antigua and Jamaica. At the present day the chief supply of cane sugar comes from the West Indies, Mexico, Brazil, Peru, and Louisiana.

The sap of some trees possess a sufficient amount of saccharine matter to furnish sugar. The principal of these are *Acer saccharinum*, L., *Acer nigrum*, Michx., *Acer rubrum*, Wangh., and *Acer dasycarpum*, L., of North America. The sugar maple (*Acer saccharinum*, L.), a stately tree, growing between the fortieth and forty-third degrees of north latitude, will furnish at least two quarts of sap in twenty-four hours in the month of March when the flow is most rapid. The yield of crystallized sugar, however, does not usually exceed two to four pounds for a single tree.

There are certain roots characterized by a predominance of saccharine juice, such as those of the Beet, the Sugar beet, the Carrot, the Celery, &c., as well as the fruits of various forest and vegetable growths; among these may be mentioned the Date palm, the Pisang, the Pineapple, the Fig, the St. John's bread, the Indian fig, &c.

The original stock of the common beet (*Beta vulgaris γ, rapacea*, Koch), as well as that of the Red beet (*Beta vulgaris γ, rapacea δ rubra*, Koch), occurs wild at the present time on the sea-shore of the Mediterranean (Greece), and grows wild in some of the islands of the Atlantic ocean (Canary Islands). This is the common mangold (*Beta vulgaris a maritima*, Koch), of which there are two sub-species, with numerous varieties, formed by cultivation, the Garden mangold (*Beta vulgaris β, cicla*, Koch), and the Beet mangold (*Beta vulgaris γ, rapacea*, Koch.) It was cultivated for food by the Greeks as it is at the present day by the Persians and natives of India. Aristophanes reproaches Euripides with the fact that his mother was a vegetable dealer and sold mangold. The Romans were acquainted with two varieties. Charlemagne ordered the cultivation of the Beet (*Betas*) on his estate, and from this it was distributed throughout Europe and has extended to North America. It is easy to understand that the number of varieties of this plant should increase very greatly, since the species shows a great inclination to varieties even to permanent ones. The leaves of the Beet furnish an excellent spinach-like dish.

The turnip, which is cultivated as a favorite article of food, both for man and beast, on account of its large, fleshy root, and sweet, pleasant taste, is derived from a plant (*Brassica campestris*, L.) growing wild at the present day in Russia and Siberia, as well as on the Scandinavian peninsula. From this, in course of cultivation, a race has been produced as *Brassica campestris*, L., and a second as *Brassica rapa*, L., our white turnip, with many varieties. The cultivation of this plant, indigenous in the region between the Baltic sea and the Caucasus, was probably first attempted by the Celts and Germans when they were driven to make use of nutritious roots. This was less the case among the Greeks and Romans.

In all widely distributed plants there is an especial difficulty in ascertaining the primitive species, especially when no longer found in a wild state; this is particularly the case with the rettig and the radish—two plants which belong among the most widely distributed cultivated plants of Europe and Asia. It seems to be well established, from recent investigation, that the two plants belong to two distinct genera. The original stock of the winter rettig is (*Raphanistrum maritimum*, Gay), a plant which grows wild from the Caspian sea to Gibralter and the coast of England, and from which the *ῥαφανίς ἀγρία* of the ancient Greeks, as well as the *Armoracea* of the Romans, does not seem to differ.

The common radish (*Raphanus sativus*, L.) comes from a more remote locality. It is probable that China may be considered as the native land of this plant, where, as in the neighboring Japan, it runs into several varieties, among them an oil plant.

Here also may be mentioned the horse-radish (*Cochlearia rustica*, Lam., *Cochlearia armoracea*, L.), the fleshy root of which is used both for

food and in the materia medica. The name *Armoracea* is derived from the Pontic word *Armon*, by which the Romans designated our rettig, and which has been recently applied by the moderns to an entirely different plant. The plant originated in Southern Russia, and the neighboring countries. Its spontaneous growth extended from Finland to Astracan and the steppes of Cumana, and even to Turkey in Europe. The name *Chren*, which the Sclavonian races used to denote this plant, accords with the German *Kren*, and the French *Cran* and *Cranson*, and indicates a by no means early introduction of the plant into these countries—a view which is substantiated by the absence of original names of the plant in the north, west, and south of Europe.

The carrot (*Daucus carotta*, L.) is of much more recent introduction as a plant of cultivation. It grows wild at the present day in the whole of Europe, North Asia, and North America, and the cultivated race returns to the wild original in a very few seasons. It appears that the Greeks and Romans cultivated this plant in their gardens, although not to any great extent. It will require further proof to show that the *Σταφιλῖνος ἄγριος* is the violet variety of the carrot.

As early as the seventeenth century the white and yellow varieties alone were known; at the present day roots are gathered of every size and color.

There is the same relationship between the cultivated and the wild plant in the parsnip, (*Pastinaca sativa*, L.), a meadow plant common in the whole of Europe. The cultivation of the long, sweet, aromatic root, in northwestern France, has already continued for many centuries, during which time several new varieties have been developed, as, for example, that with the top-shaped root. A kind of beer is brewed from it, in Ireland, and even wine has been manufactured from it.

The *Scorzonera hispanica*, L., furnishes a very pleasant vegetable. This plant grows wild, at the present day, in Central and Southern Europe, and in the East; and the slimy, sweetish roots gain considerably in palatability by cultivation. The *Scorzonera glastifolia*, Willd. and *Scorzonera picroides*, L., are somewhat similar in their properties, as are also the roots of *Scorzonera Lawrentii*, Hook, jr., in New Holland. The latter is a choice dish of the natives, and might replace the *Scorzonera hispanica*, if enlarged by cultivation. Africa has also a sweet, nutritious root, in the *Bauhinia esculenta*, Burch., of the Cape. The *Arracacha esculenta*, Bancroft, furnishes a similar nutritious root, cultivated in New Granada and Upper Peru on a large scale. The native land of this plant is no longer known, nor can we tell how far it has been changed by cultivation.

We may also introduce here the sugar root, or skirret, and the celery. The former (*Sium sisarum*, L.), obtained from the East, has been cultivated in Europe for more than one thousand years. The Emperor Tiberius is said to have demanded this sweet and somewhat aromatic root as a tribute from the Germans living on the Rhine.

The celery (*Apium graveolens*, L.), is a sea-shore plant, occurring on saline soil on the coast of the Mediterranean, in Greece, and in Turkey in its original form and of a bitter taste. It seems to have come very early into use, for Theophrastus mentions it as *Σέλινον*. At the present day, the cultivated plant is widely distributed in Greece.

It is hardly worth while to mention the root of *Campanula rapunculus*, L., formerly cultivated as a vegetable, a plant growing wild in Western and Southern Europe. The flesh of this tender and palatable root is often eaten in the spring.

We may mention here a few other plants, such as the Evening Primrose, *Gartenrapunzel* or *Rapontik* (*Oenothera biennis*, L.), from Virginia, and *Oenothera grandiflora*, Ait., likewise from North America, which are occasionally sought after on account of their sweet turnip-like roots, which they acquire by cultivation. *Oenothera suaveolens*, Desf., *Oenothera parviflora*, L., and *Oenothera muricata*, L., likewise from North America, also furnish edible roots. All these plants, like the parsnip and the carrot, have laid aside very little of their original nature. The New Zealanders, and inhabitants of the Oceanic Islands, have introduced into cultivation some only slightly-nutritious rhizomes and stems, among which are *Convolvulus turpetum*, L., upon the Society and Friendly Islands, and the New Hebrides, the soft, sweet stem of which is sucked by the boys of Otaheite. The same is the case with the rhizome and pith of *Pteris esculenta*, Forst., *Polypodium medullare*, Forst., *Polypodium dichotomum*, Forst., and *Acrostichum furcatum*, L., in New Zealand and on the Society Islands. The bark of *Hibiscus tiliaceus*, L., furnishes a kind of nutriment to these poor natives in the general want of other substances, as also the exuding gum of *Avicennia resinifera*, Forst., and the ripe, unpalatable fruit of *Pandanus odoratissimus*, L.

Among the edible root-stalks of the Ferns we may also mention *Nephrodium esculentum*, Don., in Nepal, and *Diplacium esculentum*, Sw., in the East Indies, chiefly used by the natives.

Among the plants characterized by an abundance of saccharine juice, those having sweet fruit are of very great importance, as their cultivation is usually attended with little difficulty, the yield being very copious, and their taste much more pleasant than that of the other sweet parts of plants. We will first mention the sweet and nutritious fruit of the Date palm (*Phoenix dactylifera*, L.) "In the East," says Von Martius, "the date tree has ever been considered the benefactor of mankind. The life of the wandering tribes in the desert circles around the date tree; and the Arabian poets ascribed such high importance to it that they maintain that the noble tree was not formed with the other plants, but from the clods which remained after the creation of Adam." The Persian enumerates 360 attributes as peculiar to his palm, probably with reference to the career of the sun, for the tree is consecrated to the sun, and the fruit of the date is called Sun fruit (*Belach*). In the primitive mythology of the Hindoos we find various references to this palm.

The native land of the date palm seems to have been originally in the region along the east side of the Persian Gulf, whence it has been distributed in the earliest periods of commerce to Arabia, Persia, Hindostan, and westward over the whole of North Africa. It reached the West Indies a good while ago.

The date palm occurs in the whole of Greece, and is particularly abundant on the islands, although it bears fruit only at Kalamata in the Southern Morea, and that of poor quality. Dates constitute

the principal nutriment for man, the horse, and the camel, in Arabia, Persia, and Egypt. In the oasis of the desert it is the last resort of the starving. From the great value of this palm to these countries, and its very long period of culture, it is not to be wondered at that it has already expanded into many varieties.

The Banana is of as great, if not greater, importance to the tropical zone. Both in tropical Asia and America almost every hut has its plantain tree. In the great number of different forms of plantain, the size, form, and taste of the fruit are exceedingly different. The question has long since been started as to how far this has been derived from one or several species. In America there are only two especially distinguishable forms. The *Banana da terra* (with long, straight, and decidedly three-cornered fruit, on distinct stems, and with a fresh, juicy pulp), and the *Banana de St. Thomé* (with smaller, blunt, roundish, and soft, sweet fruit). In tropical Asia and the islands of the Pacific ocean the different forms amount nearly to half a hundred. Although the Banana has not been found growing wild in America, with any degree of certainty, various points of Asia furnish, at present, this plant in its original form; a fact which speaks most decidedly for the question of its origin, as it is rarely propagated by seeds, but principally by its suckers. Roxburgh found it growing wild on the coast of Coromandel, Rumphius and Blanco on the Philippines, Loureiro in Cochin-China, Finlayson on the small island of Pulo-Ubi, near Siam, and so on to Ceylon.

The names used for this plant in Asia and America deserve a little further attention. In America there is no indigenous name, while Asia furnishes names in the Sanscrit, Chinese, and Malayan languages, even to the definition of the different forms. It is very probable that all the forms of the Banana are derived from a single stock, the original locality of which belongs to tropical Asia, since the American and Asiatic plants are scarcely distinguishable systematically; and the genus *Musa* is represented exclusively in Asia, and not in America. It will also be borne in mind that the two American forms are less connected with each other than with the corresponding Asiatic forms. It has been asserted that bananas were cultivated in America before its discovery by Europeans, but the historical notices on this point are by no means unanimous, and the fact that the bananas were carried from the Canary Islands, in 1516, to St. Domingo, is against such a supposition.

The cultivation of the true Banana (*Musa sapientum*, L.) is more widely extended than that of the Plantain, (*Musa paradisiaca*, L.), and extends from the 30° to the 35° north latitude, and in the tropics reaches a height of 5,000 feet, though under the equator it does not furnish ripe fruit at a height of 3,000 feet. The fruit, both ripe and unripe, is used both raw and cooked, and eaten with the addition of other condiments, (when ripe nearly all its starch is transformed into sugar), and in many tropical regions it constitutes the principal nutriment of man.

The Banana flourishes upon the high plain of Central America at a mean temperature of 12° Réaumur, (59° Fahr.) Upon the same surface of ground it furnishes 44 times as much nutriment as the potato,

and 133 times as much as wheat. It is more nutritious than the bread-fruit. In Central America it supplies to the poorer classes not only the place of bread, but even of meat and vegetables.

The costly fruit of the Ananas, or pine-apple, (*Bromelia ananas*, L.), is of by no means so doubtful an origin. It is indigenous in South America, and, according to the testimony of Humboldt and Von Martius, grows wild in the forests of the Orinoco, and near Bah. From this region it was transplanted to Asia and Africa. Its American name is *Nana*, and it is without a Sanscrit name. In 1592 it was carried to Bengal, and probably from Peru by way of the Pacific ocean to China. It was naturalized in Java as early as the year 1599, and was taken thence to Europe. It is highly probable that it has been cultivated in its native land from time immemorial, as it scarcely bears seeds any longer. Christopher Columbus became acquainted with it on his second journey, in 1493, on the Island of Guadaloupe; but it was not till the beginning of the sixteenth century that some of its fruit was brought to Europe, where it was elevated to the first rank among all known fruits on account of its pleasant taste. Geronimo Benzone states (History of the New World, 1568) that no fruit on God's earth could be more agreeable. Christopher Acosta (1578) calls the plant *Ananas*, and states that it was carried from Santa Cruz to the West Indies, and thence to the East Indies and China. It must, however, have been distributed with uncommon rapidity, since a few years after it was tolerably well known. About this time the first experiments of its cultivation were made in Europe, which, however, proved a failure. Several varieties of this plant have been developed which vary in the shape, size, color, and taste of the fruit. Three of these existed at the time of the discovery of America, and a fourth has since then been met with. It is still questionable whether these are not distinct species. A white kind in the East Indies, which has run wild, still contains seed in its fruit. The Ananas thrives best in Brazil. In Peru a vinous drink (chica) is made from it.

The Melon tree (*Papaya vulgaris,* D. C., *Carica papaya,* L.), or Pawpaw, *mamão*, represents the bread-fruit in America, and like this plant, is cultivated by the Indians near their huts and places of abode, and introduced by the negroes into their gardens. It is indigenous in Brazil, Surinam, and the West Indies (Jamaica, San Domingo), and from these points has been taken to Congo. Its transfer to the East Indies may have occurred even soon after the discovery of America, for as early as the year 1626, seeds were brought from the East Indies to Nepal. Its further distribution to China, Japan, and the islands of the Pacific ocean, took place only in the last century. The name *Papaya* is American, and there is no Sanscrit term for it. The fruit, about the size of a child's head, resembles the melon. It has a juicy flesh, which, however, is insipid, and can only be improved by the addition of sugar.

The Fig, (*Ficus carica*, L.), a moderately large tree, furnishes a sweet, palatable fruit, which is eaten both fresh and dried. It is indigenous to the regions which border the lands of the Mediterranean, in the East, namely, in Syria, Persia, Asia Minor, Greece, and North Africa; but has been cultivated in the same countries from time im-

memorial, even as far as Southern Germany. In the Taurus it thrives, at the present day, with great luxuriance, at a height of 4,800 feet.

The Fig had its place as a fruit tree in the garden of Alcinous, and has been cultivated longest in Syria and Palestine. Like the bread-fruit tree of the South Sea Islands, it gave to the inhabitants of the countries just mentioned their earliest nutriment, and thus formed their tree of life. The Fig, according to Magnos, first led the way to civilized life. According to one Grecian tradition, Dionysius Sycetes was the discoverer of the fig tree; according to another, Demeter brought the first fig tree to the nurseryman Phytalos; a third tradition states that the fig tree grew up from the thunderbolt of Jupiter, who persecuted the Titan Syceas, whom his mother Gæa hid in her lap. The most celebrated fig tree (ἱερὰ συκῆ) stood upon the sacred road from Athens to Eleusis. The fig tree everywhere occurs abundantly run wild, but it has probably been only found really wild by Kotschy, near Urfa, and on the banks of the northern Euphrates. The finest figs come from Sicyon and Attica, and the sycophants, even in early antiquity, were held in no special esteem. The fig tree, at least the cultivated kind, was brought to Italy from Syria or Greece, and, at the time of Pliny, was not widely distributed there, but became naturalized in Gallia and Spain.

Among the different kinds of figs mentioned by Pliny, Athenæus, Columella, and Macrobius, we may mention the Moorish, the African, the Herculanean, the Winter Fig, and the black Telainan Fig.

The fig tree is mentioned among the fruit trees of Charlemagne, although it could only be raised in forcing-houses (*per aricia servatoria*). Cortez carried the fig tree to Mexico in the year 1560. The fig is a diœcious plant, the sexes occurring on different trees. The female plant, which produces the fruit, is alone cultivated—the male growing wild. The assistance of an insect, the fig-wasp, (*Cynips psenes*, L.), is necessary to effect the fertilization, and to accelerate the growth and the ripening of the fruit. Various species have been recognized by different botanists among the cultivated figs, although all, probably, have their native land in the regions already mentioned. There are two species of figs which furnish edible food in Southern Persia, (*Ficus persica*, Boiss.), a shrub which grows wild about Shiraz, with not very palatable fruit, and *Ficus johannis*, Boiss., which is distributed in all the mountains of Southern Persia. The fruit of the latter species, the size of a hazel-nut, is pleasant-tasted and quite nutritious. Of the numerous tropical species we will only mention *Ficus aspera*, Forst., *Ficus granatum*, Forst., and *Ficus indica*, L., and a fourth variety unnamed, on the South Sea Islands, especially on Tanna, with edible fruit.

The St. John's Bread tree, or Carob tree (*Ceratonia siliqua*, L.), distributed over the Mediterranean and its islands, is of less importance. Its fleshy, sweet fruit, containing chiefly gluten and sugar, furnishes not only an habitual nutriment to man, but also serves as fodder for domestic animals. The ancient Hebrews were acquainted with the fruit of St. John's Bread, and manufactured a sweet pulp from it, and used the remainder as food for cattle. The "husks" shared with swine by the prodigal son of the Scripture parable were of this tree. The

Greeks called the fruit κερωνια, the Romans *siliqua*. They brought this as an article of trade from Africa, as is shown by the pods found in the magazines of Pompei. This useful tree was first introduced into Italy by the Arabians, where it still bears the Saracen name, *carroba* or *carruba*. At the present day we have three varieties of it.

Cassia fistula, L., has a similar fruit. It is indigenous to the East Indies, but is now cultivated in Egypt and the West Indies. The same is the case with *Cynometra cauliflora*, L., of the Moluccas, and several Mimosas, characterized by a sweet, sticky pulp, as *Mimosa inga*, L. (*Inga vera*, Willd.), in tropical America, *Inga sapida*, H. B., *Inga burgoni*, DC., *Inga insignis*, H. B.; also, *Prosopsis spicigera*, Lin., *Prosopsis horrida*, Kunth, *Prosopsis flexuosa*, DC., and *Prosopsis siliquastrum*, DC.

The elongated, oval-shaped fruit of *Opuntia vulgaris*, Mill. (*Cactus opuntia*, L.), and the *Opuntia ficus indica*, Haw., belong among the sweetish, mealy, nutritious substances. They are known, sometimes, under the name of Indian figs, and when carefully freed from their outer skin, furnish a refreshing, pulpy food in the warmer countries. The former, indigenous to Mexico and Texas, has been cultivated for a considerable period in Europe, especially in Spain, Algiers, Palestine, Syria, and Italy, and even occurs in these regions run wild, as a hedge plant. The same is the case, also, with the second variety, which is indigenous to South America, and has found a new home in Sicily and Italy. Of the other *Cactaceæ* which have mucilagenous and acid fruits, we may mention *Mamillaria simplex*, Haw., *Melocactus communis*, Link and Otto, *Cactus triangularis*, L., the so-called strawberry of Jamaica; also, *Cactus paniculatus*, Lam., *Cactus pitajaya*, DC., *Cactus divaricatus*, DC. and the fig-like fruit of *Cactus peruvianus*, L. *Pereskia aculeata*, Mill., found on the Antilles, has sweetish acid, pleasant-tasted berries.

The Saguarro (*Cereus giganteus*) of the regions adjoining upon the Gila of the United States, and south of it, (incorrectly called *Pitahaya* by some American travelers, which is *C. thurberi*,) is of much importance in the domestic economy of the Indian tribes of the country. The fruit is eaten fresh, the sap is boiled to a syrup, called "Miel de Saguarro," and a flour is prepared from the cleaned and dried seeds, which have some resemblance in appearance and taste to poppy seeds, and are contained in the fruit in great quantities. This flour is made partly into bread, and partly into a chocolate-like drink, called atole.

The population of Sonora is not unfrequently obliged to subsist entirely on the fruit of this and other species of cactus.*

We may next mention the fruit of some of the *Cucurbitaceæ*, as the Pumpkin (*Cucurbita pepo*, L.), the Cucumber (*Cucumis sativus*, L.), the Melon (*Cucumis melo*, L.), the Water melon (*Cucumis citrullus*, Ser.), the Bottle gourd or Calabash (*Lagenaria vulgaris*, Ser.), &c. These, although generally insipid in taste, furnish a pleasant food after proper preparation, and are used, on account of their copious juice, instead of refreshing drinks. All these plants belong originally

Froebel, Seven Years' Travel, &c., 1857, page 498.

to the East and to Central Asia, and have been used from a very early period as food for man and animals, although serving this purpose only to a limited extent, on account of the small amount of nutritious substance contained in them. The precise home of none of them is known with accuracy; that of the pumpkin may perhaps be Southern Asia; of the melon, the Caucasus and the southern point of the Caspian sea. The fact that the native plant of no one species is known growing wild, and the great number of varieties which most of them exhibit, rendering their systematic determination at the present time difficult, indicate a remote culture among the inhabitants of Western as well as of Southern Asia. The Jews cultivated pumpkins and melons under their kings; and it was the water melon with which they became acquainted in their Egyptian captivity, and the want of which they bewailed so loudly in the wilderness. The Greeks and Romans were acquainted with the pumpkin and cucumber, and watermelons came with the Arabians to the west. Charlemagne ordered *cucumeres*, *pepones*, *cucurbitas*, *coloquintidas*, (the three latter, forms of *Cucurbita pepo*, L.), to be planted on his estates.

After the discovery of America, most of these plants found their way to the New World, where they were distributed quickly in every direction, and subsequently reached Australia, so that even the New Zealanders are acquainted with pumpkins and melons.

We will next proceed to consider the different species of Leeks, which, although used in small quantity, belong to the nutritious plants. They are characterized by the possession of starch and sugar, with the addition of an ethereal oil. The ancient Greeks had a great fancy for these plants, raised them in their gardens, and used them as a wholesome article of food. Even in our time, this taste for the use of garlic, onions, &c. has been kept up, and an antidote found in them for various diseases.

The Garlic (*Allium sativum*, L., *σκοροδον*, Theoph., Diosc.), was planted in that division of the garden called *σκοροδωνες*. The dealers in garlic (*σκοροδοπώλης*) sold it to poor people. At the present day, the poorer class of Greeks use garlic in enormous quantities. The avaricious gave their slaves garlic to eat. A broth of garlic and salt (*σκοροδαλμη*) belonged among the dishes of the ancient Greeks. In Egypt, the priest of Isis could eat neither garlic nor onions. Garlic was avoided in Rome on account of its disagreeable odor. "*Allium olet.*"

In all probability, garlic grows wild on the Kirghese steppes of Songary, and at a very early period was transported thence over the whole of Asia (excepting Japan), North Africa, and Europe.

It is impossible to tell whether the Chive (*Schnittlauch*), (*Allium scorodoprassum*, L.), found on the islands of the Grecian Archipelago, and perhaps growing wild, is a variety of the garlic produced by cultivation, or a distinct species.

The Onion (*Allium cepa*, L., *κρόμμυον*, Theoph.), was cultivated by the Greeks in particular portions of their gardens (*κρομμυωνες*, *cepianae*), and its sale was attended to by the so-called *Ceparius*. Theophrastes distinguished several species of the onion, according to the place from which it was brought into the trade, as *Cepa sardia*, *cnidia*,

samothracia, *sethamia*, and *ascalonia*. The Island of Cimolus was endowed with the surname of Onion island (*κρομμυοῦσα*), because onions of remarkable excellence were cultivated upon it. Herodotus states that, in the building of a pyramid in Egypt, the garlic, onions, and horse radish used by the workmen cost 1,600 talents,* or 1,647,600 dollars.

At the present day, the onion is no longer found growing wild. It was probably indigenous from Western Central Asia (Palestine) to India, whence it extended to China, Cochin China, Japan, Europe, and North Africa. Soon after the discovery of America it reached there also. The Shalot, or *Allium ascalonicum*, so called from the city of Ascalon, in Palestine, seems to have scarcely a less extensive distribution than the onion. It is not cultivated in Greece at the present day, although it is frequently found in gardens in Istria and Dalmatia. This plant is probably only a variety of the common onion.

The Leek (*Allium porrum*, Lin., *πρασον*, Theoph.), was also cultivated by the Greeks in particular gardens, and was considered as an important article of food. It is certainly a Mediterranean plant, and is probably only a variety of *Allium ampeloprasum*, L., found frequently growing wild in Algiers. It has been cultivated in Europe from the earliest times, and was known not only to the Greeks, but to the Hebrews and Egyptians, being held sacred among the latter. Pliny first called it *Porrum*. At the present day it has run wild in many portions of Southern Europe, in vine hills and abandoned places of cultivation.

Having thus considered the specially saccharine plants, we take up those furnishing starch and sugar, in connection with vegetable acids. Among these belong the sweetish-sour fruits, in which sometimes the sugar and sometimes the acid predominates, and, by the addition of volatile oils, frequently acquire the most varied flavor. There is an extraordinary number of plants belonging to this division. Every part of the world has its peculiar fruits, which, however, soon become the common property of the whole cultivated earth. The hand of man has worked wonders in the improvement of flavor and yield of these plants. I have space for a rapid glance only over this rich field in a brief mention of the most important kinds.

We will take into consideration, first, the fruits of Asia, as most widely distributed, then those of Europe, and, finally, those of Africa and America.

Among the fruits belonging originally to Asia, are the mango, the rose apple, the orange, the citron, the peach, the plum, the apricot, the cherry, &c.

The Mango tree, (*Mangifera indica*, Lin.), a stout, strong tree, found native throughout the whole of India, bears a very excellent fruit, similar to that of the walnut, and the size of the fist, or even larger. It is of so excellent a taste that the inhabitants of Ormez neglect all other fruits as soon as this appears in the market. Be-

* X. Landerer on the importance of the different kinds of Allium to the ancient Greeks.—*Bester. Botan.*, *Wochenblatt*, 1855, No. 22.

neath the skin, which resembles that of the apple and pear, there is a soft, reddish-yellow, juicy, sweetish-sour flesh, which incloses a large hard kernel. The pared fruit is laid into water, in order to remove the turpentine smell and taste attached to it. The kernel, when roasted, tastes like chestnuts.

The mango is an anciently cultivated plant in the Indian Archipelago, as is shown partly from the many different names, and partly by the numerous varieties which have resulted from cultivation. It is still found growing wild in Ceylon. Its distribution has extended over India, China, Cochin China, and the islands of the Pacific ocean. It does not seem to have reached the west. At the present day, it is cultivated in Arabia and tropical America, and furnishes the best fruit in Brazil.

The Rose apple (*Jambosa vulgaris,* DC., *Eugenia jambosa,* L.), is a tolerably high tree, with globular rose-colored fruit as large as a walnut. The flesh has the flavor of roses and consistence of apples, inclosing in a wide cavity a kernel the size of a rifle ball. The tree grows wild, at the present day, upon the peninsula of Malacca and in Penang. It has been distributed throughout Malabar, Ceylon, Arabia, and Egypt to the island of Mauritius, to Sierra Leone and St. Thomas. Opinions are divided as to whether the rose apples, cultivated in Barbadoes and Brazil, belong to this species or to *Jambosa macrophylla,* DC.

The *Jambosa malaccensis,* Wight and Arn., (*Eugenia malaccensis,* Spyl.), is similar to the preceding, with more pear-shaped fruit. Its culture has been carried on for a long period in the Indian Archipelago, where it is indigenous, and has reached to the islands of the Pacific ocean and China, and, at a later period, to the peninsula of India and Ceylon even to the Mauritius.

Jambosa makapa, Mer. and Lens., furnishes a pear-shaped, edible fruit. It is cultivated on the Mauritius, and exhibits several varieties. This is also the case with *Jambolifera pedunculata,* Lour., in Southern China, the black, sweet fruit of which is an article of trade. Here, also, we may mention the fruits of *Eugenia djouat,* Perrot., of the Philippine Islands.

I may next add a number of sweetish-sour fruits, which are more or less distributed in Tropical Asia, but of which we know less than of the others. Those are: *Sapindus fruticosus,* Roxb., of the Moluccas, and *Nephelium litchi,* Camb., of China and Cochin China, cultivated also in Bengal and the West Indies. The fruit of these plants is considered the best that can be brought to the table of the Emperor of China. *Nephelium longanum,* Camb., of Southern China, *Nephelium lappaceum,* Linn., on the Malacca and Sunda Islands, as also *Nephelium rimosum,* W. and Arn., belong in the same category. We may also mention the acid fruits of *Schleichera trujuga,* W., *Schmiedelia serrata,* D. C., *Willughbeia edulis,* Roxb., *Grewia asiatica,* L., and *Grewia sapida,* Roxb., in the East Indies. The East Indian wood apple (*Johnia salacioides,* Roxb.), from Eastern Bengal, is less known than the large and pleasant-tasting Molucca apple, (*Xanthochymus dulcis,* Roxb.), and *Xanthochymus pictorius,* Roxb.

In addition to the preceding, edible fruits are furnished by *Emblica*

officinalis, Gärtn. (*Phyllanthus emblica*, Lin.), the Mirobolane, *Cieca disticha*, L., and several species of *Flacorttia*, such as *Fl. cataphrœta*, Willd., *Fl. sepiaria*, Roxb., *Fl. sapida*, Roxb., *Fl. inermis*, Roxb.; also, *Carisca carandus*, L., *Niebuhria oblongifolia*, DC., *Crataeva nurvala*, Hamilt., *Crataeva religiosa*, Forster, *Crataeva magna*, DC., and *Cicca racemosa*, Lour., the former from the East Indies, the two latter from Cochin China and China; as also *Arduina edulis*, Spgl., in Arabia.

The small pomegranate-like fruit of *Sandoricum indicum*, Cav., of the Moluccas, the mucilaginous and sub-acid fruit of *Dillenia serrata* Thunb., and *D. elliptica*, Thunb., of *Erioglossum edule*, Blume, and the excellent stone-fruit of *Lansium domesticum*, Jack., all from the Indian Archipelago, are better and more pleasant-tasted than those above mentioned.

The fruit of *Nyalelia racemosa*, Dennstedt, of Malabar, the size of the wine grape, and the fruit of *Durio zibethinus*, L., the size of a man's head, in the East Indies, and the fruit of *Mimusops ballota*, Gärt. (*Achras ballota*, Aub.), and *Lacuma mammosum*, Gärt. (*Achras mammosa*, Lin.), which have been brought from the East Indies to Tropical America, are worthy of mention; as also the fruit of *Morinda citrifolia*, L., *Maba major*, Forst., and *Solanum aviculare*, Forst., species belonging to India and the Islands of the Pacific ocean.

The Indian tamarind, (*Tamarindus indica*, L.), furnishes a pod-fruit in Southern Asia and Middle Africa, which is used for food and manufactured into cooling drinks. This large tree is planted before the houses in Senegal, Egypt, Arabia, and India. The acid pulp is used in India in the preparation of a sugar beer. *Tamarindus occidentalis*, DC., seems to be only a variety of the same plant.

We have now to mention some fruits of more general importance than those already referred to.

The citrons are characterized by the predominance of an acid pulp, the berry of which has a thick, even rind, and is divided into many compartments. There are two varieties, those are the genuine Citron or cedrate, (*Citrus medica*, L.), and the Lemon, (*Citrus medica b, limonium*, Lin.), together with a bastard form of citron or orange, the Lime, (*Citrus medica c, limetta*, Kostel.)

It is native in Tropical Asia, and has been distributed thence in all directions from the very earliest times. The Jews, who at the present day use it on festive occasions, became acquainted with it during their captivity in Babylon. It was unknown in Greece before the time of Alexander the Great. Theophrastus first makes mention of it, and states that its fruit is not edible. After the time of Pliny, it was brought to Italy, but was not cultivated there before the time of Palladius. The custom of having this fruit among clothes in wardrobes and chests, has continued to the present day. The Hesperian apple, according to the mythical statements of the Greeks, was a love gift of Gaea to the bride Hera, which she brought out at the time of her marriage to Zeus. Hercules stole this golden fruit from the garden of Hesperides, where it was cultivated only for the table of the gods, and brought it to Greece.

Royle has met with the citron growing wild at the present day in

the forests of Northern India, although in Media and Persia, it is only found as a cultivated plant. It is now distributed throughout the whole of Southern Europe, as also in America, (Brazil,) and in Congo it is domesticated.

The lemon, which is considered by many as a distinct species, is distinguished from the preceding only by the more oval and pointed fruit, of a pale yellow color and very acid pulp. The lemon has been found growing wild in the forests of Northern India by Royle. The Bengal name *Nibu*, and the Hindostan *Nimu* and *Limu*, the Arabian *Limun*, and the Italian *Limone,* seem to be derived from its Sanscrit name, *Nimbuka*. Its cultivation in the West was introduced by the Arabians. In the tenth century it was transplanted by this nation from the gardens of Oman to Palestine and Egypt, and the Crusades paved its way to Italy. At the present time it is distributed over the whole of Asia and other parts of the world.

The bitter and sweet Oranges (*Citrus aurantium a, amara*, Kostel,) *Citrus bigaradia*, Duham. (*Citrus vulgaris*, Risso), and *Citrus aurantium b, dulcis*, Kostel, (*Citrus aurantium*, Risso), have a history going back quite as far as the plant just mentioned. There is much probability for the opinion that both of these varieties, which differ only in taste, belong to a single species—the bitter orange of older, the sweet of more recent origin. The former does not occur wild, but only cultivated in India, its native country, and the latter is met with wild in Southern China, Cochin China, Sillet, and Birmah. It is not difficult to refer its name to a Sanscrit origin, *Nagrunga*. The bitter orange was distributed throughout the world, as the earlier or primitive form, at a much earlier period than the sweet orange. In the tenth century the Arabians brought it to Palestine and Egypt, and into the countries of the Mediterranean. The Arabian physicians prescribed its juice in various diseases. All chroniclers from the tenth to the fifteenth century make mention only of the bitter orange. The sweet orange has been cultivated from the earliest period in China, Cochin China, and Japan. It seems first to have passed from Hither India to Further India, and then extended its range by degrees through Asia into the West. The Arabians and the trading Genoese and Venetians seem to have contributed most to its distribution. It is probable that about the same time, the beginning of the sixteenth century, the orange was met with by the Portuguese on their journeys around the Cape to China, and planted in their own country, which was particularly favorable to its growth. At the present day it is distributed throughout the warm zone of the whole earth, and was brought to America immediately after the discovery by Columbus. Besides these two species of Citron, there are, especially in China, Japan, India, and the Indian Archipelago, still other species, such as *Citrus japonica*, Thunb., *Citrus javanica*, Blume, *Citrus decumana*, Willd., (the Shaddock), as well as a great number of varieties and hybrids, of which the *Citrus sinensis*, Pers., the Bergamot (*Citrus aurantium* e *bergamia*, Kostel), *Citrus nobilis*, Lour., and the Limette already mentioned (*Citrus limetta*, Risso.) In *Citrus chilensis*, Molina, America has also its representative of this highly useful tree.

The true Jujube tree (*Ziziphus jujuba*, Lam.), which is indigenous

to the East Indies, and the jujube bush (*Ziziphus vulgaris*, Lam.), probably belonging to India, are of less importance than the fruits just mentioned. They have a sweetish stone-fruit, similar to that of the olive. The *Ziziphus vulgaris* furnishes the well-known mucilaginous and very sweet red jujube berries, which are eaten as fruit in Southern Europe, (Spain, France, and Italy.) This plant was first brought, shortly before the time of Pliny, from Syria to Italy, but was not indigenous there, having been received from India, by way of Palmyra.

Next to the fruits of Asia, we may mention the fruits of certain Date plums, especially of the black-wooded date plum (*Diospyros melanoxylon*, Roxb.), the ebony date plum (*Diospyros ebenaster*, Retz.), and also *Diospyros kaka*, Linn., jr. The fruit of the former, which is indigenous to the East Indies, is the size of a small apple; it is yellow and juicy, but astringent and unpalatable. The second species resembles a large apple, with a mealy, acid flesh, (*meel-appels*.) The beautiful cherry-red fruit of the Japanese, *D. kaki*, has a honey-like and very pleasant taste; that of *D. glutinifera*, on the other hand, is astringent. In the southern parts of the United States, the persimmon (*Diospyros virginiana*) is a well-known fruit, exceedingly astringent when unripe, but becoming very palatable towards the beginning of winter.

Here also belong the black jujube tree (*Cordia myxa*, L.) and the Sebestan (*Cordia sebestina*, L.), both with mucilagenous fruit; the former native in the Indies, but at the present time cultivated in Egypt; the latter belongs to the West Indies. The mangosteen (*Garcinia mangostana*, L.) is limited to some of the eastern islands of the Indian Archipelago, and is not cultivated to any advantage in the West Indies. It furnishes a fruit the size of an apple, which has the taste of strawberries and grapes, and is considered the best fruit in India.

Besides this species, *Garcinia celebica*, L., *G. gambogia*, Desp., (*Cambogia gutta*, L.), *G. morella*, Desp., *G. kydia*, Roxb., *G. purpurea*, Roxb., and *G. paniculata*, Roxb., furnish edible fruit.

The Peach (*Amygdalus persica*, L., *Persica vulgaris*, Auct.) is one of the most agreeable sweetish-acid fruits of Asia. It grows best in China and Japan. Its cultivation in China goes back to the furthest antiquity. The peach is the *Tao* mentioned in the books of Confucius in the tenth century before Christ. It is no longer found wild, although forms run wild are met with wherever the cultivation of the peach has been carried on for any time, especially in the Caucasian country, in Terek, Persia, Southern Himalaya, China, &c. The native land is therefore, probably, to the northeast rather than the northwest of India, whence it extended first to Cashmere and to Bucharia, and gradually to Persia, Asia Minor, &c. The absence of a Sanscrit name for this important fruit shows that its transplantation from its native land took place before the migration of the Sanscrits.

At the time of Aristotle there were no juicy peaches raised in Greece as in Egypt, even upon the Island of Rhodes (to which point this tree probably first came from Asia Minor), and where it produced at that time only flowers and single-scattered fruit. Hence, it is probable, that what might be considered as different species of peach, are only varieties which all arose in the course of cultivation. Among these belong the fruits with naked and hairy skin, (*psilocarpæ* and *dasycarpæ*,) with

adherent and free-stone, (cling-stones and free-stones,) with white, yellow, and variegated flesh, and finally with elongated, round, and compressed forms. The peach at the present day is distributed everywhere, not only in the Old but in the New World.

The species of plums (*Prunus*), with pleasant sweetish-sour fruit, are very numerous. The most esteemed is the apricot, (*Prunus armeniaca*, L., *Armeniaca vulgaris*, L.) Alexander the Great brought the apricot from Armenia to Greece and Epirus, from which countries it reached Italy. For this reason it bears the names in this country, *μῆλα ἀρμενιακά, mala epirotica s. armeniaca, præcotia.* There are different varieties of this; some with small fruit (*A. cerasinæ* and *A. prunariæ*) and some with large fruit (*A. armeniacariæ, amygdalinæ, persicariæ*), of which the latter far exceed the former in excellence. At present, the apricot occurs wild in the regions of the Caucasus, particularly on its southern slope. In Armenia, where it was probably first cultivated, it is found run wild. It is distributed throughout the entire east, even to Cashmere and Northern India, and over Northern Africa and Southern Europe. Its cultivation is most extensively prosecuted about Damascus. A marmalade is prepared from the fruit by boiling, which is spread upon cloth, dried, and thus brought into the trade, (*Kamerdin.*)

The most generally distributed, and longest known species of plum, is the common plum (*Prunus domestica*, L.), coming originally from the Caucasus, and the mountains of Talysch. It is cultivated extensively in Syria, where it has passed into numerous varieties. It reached Italy about the time of Cato, and Pliny speaks of "*ingens turba prunorum*," by which he designated the numerous varieties. At the present day the different varieties may be referred to the following kinds: 1. The little cherry-plum, (*Prunus cerasina.*) 2. The genuine plum (*Prunus prunaria*), of a little larger size; here belong the damsons. 3. The spilling or egg-plum (*Prunus armeniaca*), which includes the mirabellas and reine claude, or green-gage plums. 4. The almond plum, (*Prunus amygdalina.*) And, finally, 5. The *Prunus persicaria.* Although the plum has been distributed over the whole of Europe, and extended far to the north, it is little known in Eastern Asia, and it is doubtful whether it occurs in Northern China.

The bullace plum (*Prunus insititia*, L.), which is closely allied to the common plum, is of slight importance. It is found wild on the Caucasus. It is difficult to decide whether it occurs wild, or only run wild in Greece and Southern Europe. This tree has certainly not been derived from the sloe bush.

Here also belongs the Bear plum (*Prunus ursina*, Kotschy), a thorny, tree-like shrub, which grows wild everywhere on Anti-Lebanon, the sweet, pleasant fruit of which, the size of our damson, is eaten not only by the bears, but serves as food to the inhabitants of the mountain regions.

Among the plums, in the most extended sense, may be mentioned the cultivated cherry (*Prunus cerasus*, L.), and the wild black cherry (*Prunus avium*, L.) The former, growing wild in the mountain forests of Southern Caucasus, was brought to Italy from Cerasunt, in Pontus, after the conquest of Mithridates, (74 before Christ.) The latter is

indigenous both in the Caucasus and Central Europe, especially in Greece. Both species have passed into a great number of varieties in the course of time, which differ most decidedly in shape, size, consistency of the pulp, in juiciness, and in taste, and may be referred to at least five easily distinguishable forms.

A small, entirely prostrate shrub, *Prunus* (*Cerasus*) *prostrata*, Labill., growing wild on the Alpine summits of Lebanon, has small cherries, which, according to Kotschy, are sought after and eaten in the entire East.

The Quince (*Cydonia vulgaris*, Pers.), with its large, yellowish, and downy pear or apple-like fruit, is still native in Asia. It was known in Greece in the earliest times, and its fruit dedicated to the Goddess of Love. Melus, a priest of Aphrodite, hung himself, from grief at the death of Adonis, to a quince tree, into which he was then transformed. The Quince is probably native to Northern India, (Hindukusch,) and was carried by way of Ispahan and Syria to Greece. Even Theophrastes knew a variety, *Στρουθιον*, the quince pear, and at a later period the quince apple, with more rounded fruit, (*κυδωνέα*, Dios,) was recognized. It was brought to Italy from Kydron, a city of the Island of Crete. (*A Cydone, Cretæ oppido, unde primum advecta*, Pliny.)

At the present day the Quince is found over all the Mediterranean regions, from Imeretea, where it occurs with fruit the size of a child's head. It has been transported from the Crimea to Spain and Algiers, where it quickly runs wild. It is cultivated in Kashmir and Northern India, though in Northern China it is replaced by another species, (*Cydonia sinensis*, Thouin.)

The Medlar (*Mespilus germanica*, L.), although distributed throughout Germany and over almost the whole of Europe, is not indigenous, but only runs wild here and there. This small, rather shrubby tree, with its top shaped apple-like fruit, is native to Northern Persia. Th. Kotschy found it on the southern side of the Albors, at a height of 6,000 feet, as a shrub 4 to 5 feet high, and covering whole mountain slopes. It was brought to Greece at an early period. Theophrastus was acquainted with three varieties. At the time of Cato it was unknown in Italy, and was first brought there from Macedonia, after the Macedonian war. The fact that the Romans met with the medlar tree in Gaul, only proves that it came there earlier in the way of trade. At the present time we distinguish apple medlars with short and pear medlars with long-stemmed fruit.

The white and black mulberry trees (*Morus alba* and *Morus nigra*, L.) possess a not unpalatable sweetish acid berry, and seem to have been brought at a very early period from their native land, North Persia, the Caucasus, Asia Minor, &c., to Greece. Theophrastes was acquainted with the mulberry tree: his *συκάμινος* is *Morus nigra*, Lin. It is only at a late period that this useful tree, which had been brought by Lucius Vitellus from Syria to Rome, was successfully reared in Italy, after all earlier experiments, according to Pliny, had been conducted in vain. At the time of Palladius, and even at that of Athaneus, the mulberry tree had multiplied but little in that country. The introduction of silk-culture under Justinian gave a new importance to this little-esteemed tree, and from that time to the present its propagation in

Western and Northen Europe, Denmark, and Sweden has taken place very rapidly. The mulberry tree has attained its greatest extent and variety of form in Persia, Northern India, and China. In the earlier periods of the silk-culture, the silk-worms were fed in Italy with the leaves of *Morus nigra*, and not until the sixteenth century did *Morus alba* take its place. At the present day both species have run into a considerable number of varieties.

We have now to mention a fruit which is cultivated more on account of the application of its sweet juice in the manufacture of drinks than as an article of food. I refer to the wine-grape. There is no uncertainty as to the native land of the grape, (*Vitis vinifera*, L.) The southern part of the Caucasian mountain chain, Armenia, and the South Caspian region exhibit it at the present day in its original form, as a tall, climbing plant, twining about the trees with small and but slightly-palatable berries. The numerous varieties which have been developed from this plant in the course of cultivation show a long-continued influence of most varied circumstances. The history of the cultivation of this plant would be one of the richest, and, perhaps, most interesting possible, since its manifold phases have certainly depended, in part, at least, upon the nature and mode of life of the plant itself. Its distribution towards the west has far surpassed that towards the east, (North India and China.) Its introduction into all parts of the world has contributed only to the multiplication of its peculiarities. At the present day wine is pressed from the wild grape on the banks of the Orontes.

The other species which occur in Africa, America, &c., and are likewise made use of, I cannot refer to here for want of space; nevertheless, the group indigenous to North America (*Vitis labrusca*, Lin.) increases in its extent of cultivation from year to year, and has already produced a small number of varieties. Even Africa has its grape, in a still undescribed species, which Russegger and Kotschy found on the Nile. It forms a low bush, the berries of which are excellent, and are collected and eaten by the negroes as raisins.

The Pomegranate tree (*Punica granatum*, L.) is to be considered rather as a plant peculiar to southwestern Asia than to the Mediterranean zone of Africa. It has been announced as growing wild in the mountains of the Atlas, and there is no doubt that Southern Europe has received it from Africa. Nevertheless, the fact of its very ancient cultivation in Palestine, Persia, Northern India, and its occurrence, not only run wild, but truly wild in Asia Minor, Armenia, Southern Caucasus, and Northern Persia, show that its early native land was Western Asia. From this it has been distributed, eastward, to Northern China, but principally in a western and southern direction. According to Athenæus, Aphrodite first planted the Pomegranate on Cyprus and in Greece. It experienced its first cultivation in the district of Sidai. The fancy of the Greeks derived this fruit from the blood of Dionysius Zagreus. It was known in Egypt, and cultivated even in the time of Moses. It was raised in the gardens about Carthage. Darius Hystaspes* eats of its fruit. Homer makes mention

* Herodot. iv, 143.

of it as existing in the gardens of Alcinous. The Romans brought it from Carthage to Italy, for which reason they called its fruits *Mala punica*. Pliny enumerates nine different kinds of Pomegranate, which at the present day have multipled very greatly. When wild, it is a shrubby plant with not very large fruit, but by cultivation it attains the size of a tree, the fruit of which is as large as an apple, and possesses a pleasant acid pulp. Three principal varieties are distinguished, namely, with sour, sub-acid, and sweet fruit. The inclination it has to run wild seems peculiar to this plant; for even at the borders of its distribution to the north, as, for example, in Southern Tyrol and Southern Switzerland, it is met with run wild, as also in Spain, Southern France, Greece, and Abyssinia.

We may here mention a few more sweetish-acid fruits of the Old World, even though of no greater importance. Among these are several Palms, such as *Zalacca edulis*, Reinw. (*Calamus zalacca*, Gärtn.), of the islands of the Indian ocean; *Elate silvestris*, Ait., likewise found in the East Indies, and *Arenga saccharifera*, Labill. These fruits, partly in a ripe and partly in a half-ripe condition, furnish a pleasant-tasted article of food.

I may further mention *Celtis australis*, L., the sweet, honey-like fruit of which serves as an article of food in Southern Europe, North Africa, and the East, also several species of *Elæagnus*, and our native Elder (*Sambucus nigra*, L.) The olive-like fruit of *Elæagnus angustifolia*, L., especially in Turkey and Persia, is large, and pleasant tasted, on which account it is sought after, and even occurs dried, in commerce. This is less the case with *Elæagnus orientalis*, L., *E. arborea*, Roxb., and *E. conferta*, Roxb. The fruit of the Philippine oleaster (*Elæagnus philippensis*, Perrot.) has the taste of the best cherries.

Only a few species of fruits are peculiar to Africa, and those have been brought from that country as the common property of cultivators. We may mention first all the edible Jew Thorn, or the African Date plum, the Lotus of the ancients (*Ziziphus lotus*, Lam.); a shrub, the roundish, purplish fruit of which, having the appearance of sloes or olives, and a sweet taste resembling figs or dates, constitute the Italian Jujube berries. This shrub is chiefly found in Tunis, but has been distributed into the interior of Africa. This plant was described by Polybius. According to Theophrastes, the λωτὸς was so common on the island of the Lotophagi (Zerbi) that a Roman army, on its way to Carthage, was nourished several days by its fruit. Homer also mentions this attractive fruit, from which Ulysses succeeded, only by violence, in turning away his companions. At the present day this fruit is used in the smaller Syrtis, and is called by the Arabians *Nabka*, and the bush *Seder*. It is not known when this tree was brought to Southern Europe, where it is cultivated at the present time.

Western Africa has its *Chrysobalanus ellipticus*, Soland., and *Chr. luteus*, Sab., corresponding to the American Icaco plum.

Of a less extended distribution are *Anona senegalensis*, Juss., *Schmidelia africana*, DC., which occur along the entire extent of the coast of Senegambia, and *Grewia megalocarpa*, of Guyana; as also the Pear tree of Guinea, *Salacia senegalensis*, DC. The fruit of the African

Mammey tree (*Mammea africana*, Don.) The pleasant-tasted wine-like fruit of *Sapidus senegalensis*, Poir., called the Cherry of Senegal, and the fruit of a *Bursera*, (*Safu*,) which is cultivated everywhere in Congo along the villages, are more highly prized. The fleshy fruit of *Pappea capensis*, Ekl. and Zeih., of the Cape, the seeds of which furnish oil; the orange-yellow berries of *Strychnos spinosa*, Lam., only edible in the ripe state, and the berry-like fruit of *Sodada decidua*, Forsk., in Egypt, and even the fruit of the Baobab, *Adansonia digitata*, L., furnish only a scanty nutriment. Another fruit which deserves mention, on account of its butter-like fruit, which the natives of Sierra Leone make use of, is *Pentadesma butyracea*, also *Dialium nitidum*, Guill. and Perrot.

Balanites aegyptiaca, Delil. (*Ximenia aegyptiaca*, L.), a tree with edible fruit, is also peculiar to Africa. It is abundant in Nubia, from 20° N. latitude to beyond Sennaar, and at a very early period was transplanted to Egypt. It was brought by the negro slaves to St. Domingo from Senegambia, where it is likewise found. The fruit is sweet; the seeds contain oil. The *Hyphaene thebaica*, Del., indigenous to Upper Egypt, (Dongola,) furnishes but a scanty flesh. It is eaten only in cases of need, although, according to Kotschy, beer is brewed from it. The fruit of *Ficus sycamorus*, L., the Asses fig, is not of much greater value. It has a somewhat aromatic taste; is brought to the market in Cairo, and is eaten throughout the entire East. Kotschy has frequently eaten, in Fazokl, a fruit of *Diospyros amoena*, Wall., which has a taste similar to chocolate. The best native African fruits, one not dissimilar to our peach, is that of *Paranarium senegalense*, Guill. and Perrot., a tree distributed from Senegal throughout Africa to Fazokl. The fruit of *Detarium senegalense*, Gmel., is also similar to the preceding. It has a greenish, mealy flesh, of a sweet taste, although somewhat sharply acid. It is eaten in great quantity, both in Senegal and Eastern Africa (Fazokl).

Europe furnishes only a small number of sweetish-acid fruits. Of these the apple and pear are of most importance. Others are species of *Sorbus*, *Crataegus*, and *Cornus*, some kinds of *Ribes* and *Vaccinium* as also various *Rosaceae* (*Fragaria*, *Rubus*.) Both the pear (*Pyrus communis*, L.) and the apple tree (*Pyrus malus*, L.) are native in the mountain forests of temperate Europe, as also in the Caucasus. The pear tree in Balkan even forms large groves, while elsewhere, like the apple tree, it is more or less solitary. These two plants, with small, acid, and bitter fruits, have been an object of cultivation from time immemorial. They have been altered in the most varied manner, and now furnish the most palatable and enduring of fruits, which are eaten both fresh and dried, and in many regions furnish an abundant subsistence. Both pears and apples were raised in the gardens of the Pheaecians, and Thasos was celebrated in ancient times on account of the excellence of its pears. The primitive festival of the Ballachrades of the Argives with the wild pears (ἄχρας) has reference to this first article of food of their forefathers. The Jews were acquainted with greatly improved varieties of the pear, but the Romans first occupied themselves more closely with its cultivation, and produced numerous varieties, among which we may recognize, in part, the kinds of apples

and pears of the present day. Many of these, as for example *Malum appianum*, were introduced by Appius from Greece.

If we review the progress of the cultivation of these two fruit trees we find that Theophrastes knew three kinds of pears and two of apples; Cato knew six kinds of pears and seven of apples; Pliny knew forty-one kinds of pears and thirty-six of apples; Palladius knew fifty-six kinds of pears and thirty-seven of apples.

Since then, owing to the constant efforts of cultivators, they have increased more than thirty-fold, so that at the present day we are acquainted with over 1,500 varieties, often differing extremely from each other in the size, form, taste, and consistence of the fruit.

At the present day neither the pear nor the apple occurs wild in the East. Landerer* states that the wild pear tree grows in Greece, particularly in the Morea, on the driest declivities of the mountains, as a small shrubby and thorny plant, and that the fruit is by no means pleasant. Between Shiras and Ispahan, Kotschy found a village with large plantations of pear trees, but was not able to ascertain with certainty whether they were the same as our *Pyrus communis*.

With reference to the apple, it is remarkable that in the entire East only summer apples are cultivated, never the kinds which can be kept over winter.

The common pear, from its naturally wide circle of distribution, would necessarily receive a great variety of appellations. The Celtic word *Peren* will serve as the primitive word for the greater portion of Middle, Southern and Western Europe; and even the Grecian *ἄπιος*, which was constantly used for the cultivated form, may have been derived from it. The names used by the Sclavonic nations, as well as those of the Persians, Arabians, and Chinese, among which this has been cultivated, are very different from these.

The apple tree, of less extensive distribution, has nevertheless a more universal primitive name, which consist in the root *Ab*, *Ap*, *Al*, *Av*, whence also is derived the latin word *Malum*, which differs little from the Grecian *μηλέα*. The Sanscrit, Arabian, and Chinese words for the apple are entirely distinct from those just mentioned.

It may be mentioned, in addition, that besides this species of *Pyrus*, the East possesses still other indigenous, partly shrubby, and partly tree-like species, the fruit of which is eaten to some extent. Among these may be mentioned *Pyrus glabra*, Boiss., in Southern Persia, and *Pyrus syriaca*, Boiss., a tree exceeding our pear tree considerably in height, the mellow fruit of which is used as food in the autumn.

The Service apple, (*Sorbus domestica*, L.), indigenous in the mountain forests of Southern Europe, and even cultivated here and there, is of much less importance. The Romans were acquainted with four different kinds of it.

The wild service berry (*Crataegus terminalis*, L., and *Crataegus aria*, L.), both found in the mountain forests of Middle Europe, and the Azarole, (*Crataegus azarolus*, Willd.), in the middle Mediterranean region, are of equally little value. *Crataegus trilobata*, Labill., found on Lebanon, comes likewise in the same category. The small berry-

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*Oesterr. bot. Wochenblatt, 1856, p. 355.

like fruits of a pleasant flavor, and tasting like pears, according to Kotschy, are frequently collected and brought to market in Damascus.

To these insignificant fruits may be added the Cornel cherry, (*Cornus mascula*, L.), though much more widely distributed than they are. Homer and Theophrastes mention this hard-wooded tree, which grows very abundantly in Thessaly and Macedonia, as well as in Asia Minor. The cornel was at one time preferred for the shafts of lances to any other wood. The Romans used its fruit fresh, dried and put up in salt, and fed swine with it, as was the case formerly in the regions of the Rhine and Moselle. There are several varieties of it, among which there are even some with yellow fruit.

Diospyros lotus, L., a woody shrub of Southern Europe and Northern Africa, has a fleshy and not unpleasant fruit somewhat like the sloe. A vinous drink is prepared from it in many places.

As many species of *Ribes* are peculiar to Europe, it may be well supposed that the Red currant (*Ribes rubrum*, L.) and the Gooseberry (*Ribes grossularia*, L.) are likewise indigenous here. In fact, the former species has a distribution extending over the whole of Northern and Middle Europe, and reaching even to Kamtschatka and the whole of northern North America. This berry was not known to the Greeks and Romans, and it seems that it first made its appearance in our gardens in the middle ages. The currant was cultivated earlier in Northwestern France than in England, where it first appeared without a name at the end of the sixteenth century. The names *gardes*, *grades*, and *gradilles*, in Normandy, certainly had their origin in the Celtic word *gradiz*, meaning *sour*. The name *Ribes* seems to owe its origin rather to the Scandanavian *Risp* and *Reps* than to the Arabian *Ribes*. In Italy, where the currant is little cultivated, it is called *Uva di fratri*, which has reference to a monkish origin. The "Masterly Book of Medicine and Plants, 1497,"* of Johannes Tollat, of Vochenberg, is the first botanical work in which the currant occurs under the name of *Ribes joanis*. The French name *Groseille d'outremer*, and the name *Raisin de mare* (Meertrübli), used in Switzerland, may be easily explained.

The parent plant of the Gooseberry is the *Ribes uva crispa*, L., very common in Europe, although the gooseberry itself actually occurs run wild escaped from gardens. Its distribution extends furthest towards the north. In England, four hundred varieties are known, differing very much from each other in color, size, taste of the berries, &c. The cultivated gooseberry, as well as the currant, has become widely known in North America. The names *Grossularia* and *Groseille* are probably derived from the German *Krausbeere* or *Krausebeere*. The Celtic, Breton, and Sclavonic names are entirely different. A still undescribed species on Lebanon and Hermon, according to Th. Kotschy, furnishes palatable fruit to the inhabitants of the mountains.

The genera *Fragaria* and *Rubus* furnish smaller acid fruits. Three species of Strawberry occur in Europe, the fruit of which furnishes a delightful dish: these are the common strawberry (*Fragaria vesca*, L.), the garden strawberry (*Fragaria elatior*, Ehrh.), and the hard strawberry (*Fragaria collina*, Ehrh.) The first of these is the longer known

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*Sprengel, Gesch., i, p. 297.

and most widely distributed plant, the two others are rarer and only occasionally met with. The forest and garden strawberry are cultivated everywhere, though not for a very long period. Numerous varieties have arisen from them, differing from each other in size, color, and quality of the fruit.

At the present day the Scarlet strawberry (*Fr. virginiana*, Mill.), the Pine apple strawberry from Surinam (*Fr. grandiflora*, Ehr.), and the Chilian strawberry (*Fr. chilensis*, Ehr.), are also cultivated in gardens.

The Blackberries belong to our native fruits, while the greater number of the species of *Rubus* furnish only slightly valued fruits. The *Rubus idaeus*, L. or Raspberry, and the Cloudberry, peculiar to the far north, *Rubus chamaemorus*, L., as well as *Rubus arcticus*, L., are much esteemed. The first species is cultivated in our gardens at the present day, and is mentioned even by Palladius as a garden plant. Both Strawberries and Raspberries lose their pleasant taste by cultivation in hot regions.

Various species of *Vaccinium* furnish a not unacceptable fruit in certain countries, owing to the very great number of individuals distributed over entire forests, heaths, and moors. Their fruit is used both fresh and dried, and cooked in various ways, and is even employed in the preparation of drinks. Among them may be mentioned the common Heathberry (*Vaccinium myrtillus*, L.), the Moorberry (*Vaccinium ulginosum*, L.), the Cowberry (*Vaccinium vitis idœa*, L.) The American Cranberry, *Oxycoccus macrocarpus*, furnishes a berry which is highly prized; it grows abundantly in boggy and peaty places in the Northern United States and British America, and is beginning to be cultivated very successfully. The Sandberry (*Arbutus unedo*, L.), without any peculiar taste, is a small evergreen, growing in Southern Europe and Middle Asia; it has fruit resembling strawberries, which ripens in the second year, becomes first yellow and then red.

Australia is still very sparsely provided with fruits. The most useful indigenous fruit tree is the peach-like *Quandang*, (*Fusanus acuminatus*, R. Br.) Of less importance are the fruits of *Santalum lanceolatum*, R. Br., *Mesembryanthemum aequilaterale*, Haw., and *M. praecox*, Mill., *Leptomeria pungens*, Mill., and *L. acerba*, R. Br. *Sambucus xanthocarpa*, Mill., *Nitraria billardieri*, DC., and several species of *Exocarpus*, *Leucopogon*, and *Lissanthe*. The berry-like fruit stem of *E. cupressiformis*, Sab., are particularly remarkable, as also the berries of *Coriaria sarmentosa*, Forst., a shrub growing wild in New Zealand. The New Zealanders use besides this the berries of *Dracaena indivisa*, Forst.

America, on the other hand, furnishes a much richer supply of pleasant-tasted acid fruits. We may first mention the Cashew tree, caju, acaju (*Anacardium occidentale*, L.), a large wide-spreading tree of the family of *Terebinthaceae*. The fruit consists of a pear or cucumber-shaped fruit stem on which is a large brown nut. The two are used both raw as well as cooked, and made into dishes. The fruit stem when ripe has an acid taste, and the kernel, when peeled and roasted, tastes like chesnuts. The natives of Brazil often go to war with each other on account of this fruit, and the conquerors establish themselves about the trees till the fruit is all consumed. The tree is

indigenous to the West Indians, Central America, Guyana, Peru, and Brazil, and is cultivated there also.

The Portuguese transplanted this useful tree as early as the sixteenth century to the East Indies and Indian Archipelago. All its names point to an American origin. Its existence on the eastern coast of Africa is of still more recent date, while neither China, Japan, or the islands of the Pacific ocean are acquainted with it. Its fruit stem is sometimes longer and sometimes shorter, varying with the influence of cultivation, In the Asiatic plant the stem is always shorter.

The American Mammey tree, (*Mammea americana*, L.), sixty to seventy feet in height, is one of the finest trees of the Antilles, with its pyramidal crown, the largest berries of which, from three to seven inches in diameter, furnish a much prized fruit. The outer and middle epidermis are leathery and tough, the inner skin bitter, while the yellow pulp is more spicy and palatable, and is used raw, and prepared in various ways. Though it is cultivated in the West Indies, experiments have not been made to propagate it more extensively.

The fruit of *Mammea emarginata*, Sess., is eaten in Mexico.

The Avocado Pear, or Abacate, (*Persea gratissima*, Gärt.), is the most highly prized fruit of Brazil. It is like a large pear, with a green, leathery rind, and tender, juicy flesh, which incloses a hard nut, like a walnut. The flesh, made into a sauce, with citron juice and sugar, has a delightful taste. One fruit is sufficient for three or four persons. In itself the flesh is insipid, but tender and soft, tasting like artichokes. Moritz Wagner says it may be called vegetable butter, as it melts upon the tongue. This very large tree flourishes only in the warmer countries of Brazil. Its real native country is Central America, Mexico, and the northern part of South America, whence it has been distributed by cultivation to the Antilles. It seems to have been cultivated longest in Mexico under the name of *Ahuaca*. It has been naturalized on the islands of Bourbon and Mauritius since 1758.

The guavas of America are of much importance for the abundance of their yield. The pear guava (*Psidium pyriferum*, L.), is distinguished from the apple guava (*P. pomiferum*) by the shape of the fruit, that of the former being pear-shaped, that of the latter being globular, and varying from the size of a plum to that of an apple, and resembling an orange. Under the firm leathery shell, there is the soft flesh which passes inwards into a beautiful rosy-red pulp, inclosing numerous small kidney-shaped, hard seeds. The fruit of the first-mentioned species tastes like strawberries and raspberries; that of the latter is somewhat bitter, but, with the addition of sugar, becomes very palatable. At the present day, it is not decided whether these two plants are of one species, or mere races or varieties; though there seems to be more reason for the latter than for their specific distinction.

Both forms belong to the tropical main land of America, from Mexico to Brazil, and have, probably, been carried thence to the West Indies. The trees are thin-stemmed and rather low, but bushy; and, at the present day, grow wild or run wild in many places, especially in the vicinity of settlements. They were first distributed in various directions by birds and beasts, which eat their fruit greedily, and drop

the seed undigested. Their cultivation has been carried on by the primitive inhabitants of those countries from time immemorial, as is shown by the fruit, which is frequently without seeds. This plant first reached the East Indies through the agency of the Portuguese and Spaniards. It is remarkable that *Psidium pomiferum* has been propagated there more than *Psidium pyriferum.* It is only recently that the guava has extended to China and the Philippine Islands; and it has, thus far, advanced neither to Japan nor to the islands of the Pacific ocean. It has only recently been introduced on the west coast of Africa and the Island of Mauritius.

It is uncertain whether *Psidium sapidissimum,* Jacq., with its dirty yellow fruit, the size of a plum, is a variety or not of *Psidium pomiferum,* of which, besides, there are numerous varieties. The other species of *Psidium,* such as *Psidium aromaticum,* Aubl., *Ps. cattleyanum,* Sabine, *Ps. grandiflorum,* Aubl., *Ps. guineense,* Sm., and *Ps. lineatifolium,* Pers., have likewise edible fruits, but are not much known.

We may here also mention the large egg-shaped fruit of *Grias cauliflora,* L., the anchovy pear of the West Indies.

Our cherry is replaced in Southern America by the *Pitanga* (*Eugenia michelii,* Lam.), indigenous principally in Cayenne, as well as by the Jabuticaba (*Eugenia cauliflora,* M.) The fruit of the latter is the size of our oxhart cherry; and, under the tender black epidermis, there is a white, soft, and even juicy flesh, in which are two or three seeds. It is inferior in taste to our cherry. In Brazil, it ripens at the end of winter, (September, October,) and, as it is the only fruit which can be had fresh at that time, is very much esteemed. Both species have been planted on the Antilles, and even introduced into the East Indies.

Eugenia floribunda, West., and *Eugenia brasiliensis,* Lam., also furnish edible fruit.

Another fruit, the size and shape of our plum, the ibametara, or Spanish plum, is obtained from a tree (*Spondias myrobalanus,* Jacq., *Spondias purpurea,* L.) which grows wild in the forests of Jamaica, and is cultivated in the northern regions of the tropical parts of Brazil. The natives eat the sweetish acid flesh, prepare a sauce, and manufacture drink from it.

Another species of the same genius (*Spondias dulcis,* Lam.) is found on the Friendly Islands. The tree is 50 feet high, with a straight trunk the thickness of a man, and bears clusters of large, oval, golden yellow, stone fruit, like pomegranates, the fleshy putamen of which is sweet and palatable, and reminds one of the pine-apple. The *Spondias tuberosa,* Aruda, and *Spondias lutea,* Lam., (*Spondias mombin,* Jacq.), in the West Indies, also furnish edible fruit.

The Icaco plum (*Chrysobalanus icaco,* L.) is also worthy of mention. This tree-like shrub, with its fruit similar to the damson, grows wild as well as cultivated in the forests along the shores of South America, and on the wet coasts of Carolina. It has been introduced from Africa, where it occurs from Senegal to Congo. The fruit is made into preserves, and brought to Europe.

The common Sapodilla or Zapota (*Sapota achras,* Mill., *Achras sa-*

pota, L.) furnishes a much-esteemed fruit. The tree is 50 feet high, with an expanding crown, and is still to be met with in its wild state in the forests of Venezuela and the islands of the Antilles. Although it has been long ago introduced into the gardens both there and in South America, it has but recently found its way to Mauritius, to Java, to the Philippine Islands, and even to the Indian continent. The medlar-like fruit, of a milky, quince-like taste and form, is a much-esteemed fruit in the whole of tropical America. There are several varieties of this plant.

The genus *Anona* is rich in species furnishing very pleasant fruit. They belong, with the exception of a single species, *Anona senegalensis*, Juss., already mentioned, exclusively to America, whence they have been distributed to other parts of the world. The following species may be mentioned more particularly:

The Sugar Apple (*Anona squamosa*, L.) has a conical or pin-shaped fruit, (whence it is called Pinha in Brazil,) with a greenish, imbricated, scaly shell. The flesh is white, full of long, brown granules, very aromatic, and of an agreeable, strawberry-like, piquant taste. In Costa Rica it is the most valuable fruit of the country. It is uncertain whether the native land of this tree is to be looked for in Mexico or in the plains along the mouths of the Amazon. Von Martius found it forming entire forest groves in Para. Its cultivation in tropical America and the West India Islands undoubtedly goes back very far. It, of course, could not be otherwise than that so useful a tree should be transferred to the Indian Archipelago just as soon as trade with these two parts of the world was established. Accordingly, it was carried to Cochin China, China, the Philippines, and throughout the whole of India with very great rapidity, so that we should be in doubt whether it was actually introduced, and was not really indigenous, had we not sufficient grounds to substantiate its American origin.

A second species is the *Anona muricata*, L. This tree bears a large, fleshy, juicy, and well-flavored fruit, of a sweetish acid taste, like *Ribes nigrum*. It grows wild on the Antilles, (Barbadoes, Jamaica), but in Surinam has only escaped from gardens, and is cultivated in the whole of Brazil, Peru, and Mexico. In Jamaica the fruit is only sought after by negroes. The plant has quite recently been carried to Sierra Leone.

Botanists are not agreed as to whether *Anona asiatica*, L., which is cultivated in Cochin China, is to be referred to this or to the following species.

The third American species is the *Anona reticulata*, L., with brown berries the size of a man's fist, which constitute a highly-prized fruit. It is native to the forests of the Antilles, especially to Barbadoes and Jamaica, but it is cultivated in Peru and Brazil.

The *Anona cherimolia*, Lam., originally from Peru, seems to be naturalized only in the mountains of Port Royal, in Jamaica. Venezuela, New Grenada, and Brazil only know it as a plant of cultivation. It has been carried to the Cape de Verd Islands, and to Guinea.

We may mention, also, in conclusion, *Anona paludosa*, Aubl., a small tree, the height of a man, growing upon marshy meadows, with elongated yellow berries the size of a hen's egg, which have a juicy

flesh. Also, *Anona palustris*, L., in the West Indies and South America, with fruit the size of the fist; *Anona punctata*, Aubl., from Cayenne, with palatable fruit of a reddish, gritty, and granular flesh; *Anona longifolia*, Aubl., also found in Guyana, has round fruit, the size of the fist, the flesh of which is excellent and is very much prized by the Caribs; *Anona cinerca*, Dunal; *Anona mucosa*, Jacq., in the West Indies and Guyana; and, finally, *Anona tripetala*, Ait., from Peru. The fruit of the latter, known as the *Cherimoyer*, the size of the fist, with white, sweet, and pleasant-smelling flesh, is ranked among the best in the land. (Pöppig's Travels, xi, p. 135.)

Some other acid fruits are furnished by *Sapindus esculentus*, St. Hil., *Sterculia chica*, St. Hil., and *Schmidelia edulis*, St. Hil., in Brazil; *Rheedia lateriflora*, L., in the Antilles, as also *Malpighia punicifolia*, L. (Antilles cherries), and *Byrsonima spicata*, D C.; also, *Melicocca bijuga*, L., *Hancornia speciosa*, Gomez, and *Couma guyanensis*, Aubl. The gooseberry-like fruit of *Melastoma arborescens*, Aubl., *M. flavescens*, Aubl., *M. guyanensis*, Poir, *M. spicata*, Aubl., *M. succosa*, Aubl. (the *Coca Henriette* of the French), and *M. tococa*, Ders., are of little value, as is also the case with the berries of *Ambelania acida*, Aubl., of Guyana, of *Fuchsia racemosa*, Lam., and *Fuchsia denticulata*, Ruiz and Pav., of South America. The same may be said of the fruit of *Podophyllum peltatum*, L., *Podophyllum callicarpum*, Rafin, the May apple of North America.

We may also mention the Persimmon or Date plum (*Diospyros virginiana*, L.) of North America, already referred to on a previous page. Its fruit can only be used in a perfectly ripe state, when it is of a pleasant sweetness and quite nutritious. Previous to this it is excessively astringent. Drink is made from it. It is also found in the gardens of Europe. *Cerasus virginiana*, Michx, and *Cerasus cepollin*, D C. of Mexico, are species, the latter of which is frequently cultivated on account of its pleasant taste.

The acid fruits of a few palms, such as *Corypha cerifera*, Arrud., and *Mauritia vinifera*, Mart., of Brazil, belong in this connection.

The group of nutrimentitious plants to be last mentioned is characterized less by the presence of one or other vegetable substance, than by a mixture of starch, gum, sugar, wax, albumen, &c., to which here and there may be added various peculiar vegetable principles. These are the green garden vegetables, such as species of cabbage, kale, spinach, lettuce, asparagus, artichokes, &c., which are used sometimes in the leaves or young shoot, sometimes in the flowers, as they contain a proportionally small portion of nutriment. They are seldom eaten raw, but are cooked up in combination with other substances.

A peculiar character is given to those nutrimentitious plants by the no small amount of vegetable acids, alkalies, and earths which they contain. Among these may be mentioned malic acid, oxalic acid, potash, soda, lime, and magnesia, which make their use, in connection with meat, particularly advantageous, on account of their tendency to render the latter more digestible and soluble. The amount of nutriment of the green herbaceous parts of plants is still more scanty, and, strictly considered, they have little to entitle them to the name of escu-

lent vegetables, such, for instance, as the leaves of *Ranunculus ficaria*, the beech, &c.; and it is somewhat astonishing that these could ever have been used as nutriment for man, except in time of famine.

The youngest shoots and the young leaves of various palms, though in reality limited to the tropical zone, furnish most important and productive esculent vegetables. The principal of these is the cabbage palm, called, also, cabbage tree (*Euterpe caribæa*, Spgl., *Areca oleracea*, Jacq.) This stately palm, 200 feet in height, is native in the whole of the West Indies. The "cabbage," prepared in various ways, forms a pleasant dish; as a preserve, it has even found its way to Europe. Three other species, *Cocos oleracea*, Mart., *Euterpe oleracea*, Mart., and *Euterpe edulis*, Mart., indigenous in Brazil, are likewise known on account of their cabbage. The Palmetto (*Chamerops palmetto*) of the southern United States is also made use of for a similar purpose. The mountain cabbage and the *manico* palm, upon which Schomburgk lived almost exclusively for weeks, on the banks of the Oronoco, probably belongs to one of these species.

The Old World, also, has its cabbage palm. Among these, may be mentioned the cocoa tree, the young top of which contains a succulent mass, which is sweet and tastes like hazel-nuts, and is considered a choice dish wherever it occurs. Other cabbage palms are *Areca glandæformis*, L., and *Areca humilis*, L., found in the Moluccas, and *Sagus raphia*, Lam., in Malabar and Guinea; also, *Corypha umbraculifera*, L., *C. rotundifolia*, Lam., and *Caryota urens*, L.

Australia, also, in *Corypha australis*, and New Zealand, in *Areca sapida*, Soland, have nutritious cabbage palms.

Even the Date palm, the fruit of which is so useful, is here and there robbed of its soft top and leaf-buds, which the Arabians and Persians consider one of the choicest dishes.

A very important dish is furnished in the regions of the Blue Nile by *Musa ensete*, Bruce. Although the fruit of this plant is not palatable, and rarely eaten, the young stems, on the other hand, furnish a better article of food. The white marrowy portion, freed from the rind and cooked, has the taste of the best wheat bread, and dressed with milk and butter, supplies a very excellent, wholesome dish. The plant occurs even in the Egyptian antiques, and seems to have been more widely distributed at an earlier period than at the present day. Large plantations of it occur at Maitsha and Goutto, (Gondar?) according to Bruce.

We do not often meet with a plant exhibiting so many forms in its variations from the original type as the Cabbage (*Brassica oleracea*, L.), the different races and varieties of which may be estimated at 30 or more. No kitchen-garden in Europe is without it, and it is distributed over the greater part of Asia, and, in fact, over most of the entire world. The original plant undoubtedly occurs wild at the present day on the steep chalk rocks of the sea province of England, and on the coast of Denmark, (Seeland,) and of Northwestern France; and it is a question whether this marine plant did not at one time have a much wider distribution when the climatic peculiarities of Europe were different from what they are now. Other species of *Brassica*, very nearly allied to the preceding, such as *Brassica balea-*

rica, Richl., *Brassica insularis*, Moris, and *Brassica cretica*, Lam., belong to the Mediterranean flora, and it is perhaps possible that some of these species, likewise introduced into the gardens, and established as cultivated plants, may have mixed with each other, and thus have assisted in giving rise to some of the many races cultivated at the present day.

It is very remarkable that the European and Asiatic names used for different species of cabbage may all be referred to four roots. The names Kopfkohl, Cabus, Cabbage, Kappes, Kraut, Kapost, Kaposta, Kapsta (Tartar), Kopee (Bengal), Kopi (Hindostan), have a manifest relation to the Celto-Sclavonic root *Cap*, or *Kap*, which in Celtic means head. *Brassica* of Pliny, is derived from the Celtic, Bresic, (cabbage.)

The Celto-Germanico-Greek root *Caul* may be detected in the word *Kaol* (Breton), the Grecian *καυλιον* of Theophrastes, the Latin *Caulis;* also in the words *Caulx, Cavolo, Caou, Kohl, Kale, Kaal* (Norwegian), *Kohl* (Swedish), *Col* (Spanish), *Kelum* (Persian); finally, the Greco-Germanic root *Cramb, κράμβη*, passes into *Krumb, Karumb* of the Arabians, and probably into the German *Kraut*, which originally indicated the cabbage plant, but subsequently became a generic name.

The want of a Sanscrit name shows that the cabbage tribe first found their way at a later period to India and China. Even in the time of Thunberg it was wanting in Japan.

The young shoots of *Brassica cretica*, Lam., were formerly used in Greece as a dish.

Brassica carinata is allied in habit to *Brassica nigra;* it is found wild in Abyssinia, and is also cultivated there; although it furnishes very poor cabbage, not to be compared with ours.

It seems pretty well established that our Lettuce (salad), *Lactuca sativa*, L., is not a true species, but rather a variety of *Lactuca scariola*, L., indigenous to the Southern Caucasus and the neighboring regions, and thence distributed over the whole of Europe to Altai. The lettuce plant is no where found wild, though continually met with run wild. The ancient Greek cultivated two varieties, *L. capitata* and *L. crispa*, and lettuce was known to the Persians in the time of Cambyses. It is called *θιδαξ* by Dioscorides, and it even now belongs among the most prized dishes of the Greeks. The common people are satisfied with raw lettuce, eaten with a few olives and a piece of bread and cheese. Pliny was already acquainted with all our most important varieties of the cultivated plant, especially *L. capitata, L. crispa, L. laciniata*, &c. The Roman family of the Lactucini was noted for its lettuce beds, (*Romani quidem in Valeria familia ob diligentem lactucarum curam Lactucini appelant*. Plin., 19, 4.) At the present day the lettuce plant is distributed, not only over the whole of Europe and Asia (Cochin China, Northern China, and Japan), but also over all other parts of the world. Schultz, quite recently, has been inclined to recognize the parent plant of *Lactuca sativa*, L., in specimens brought by Th. Kotschy, from the savannas of Cordovan.

The origin of the Endive (*Cichorium endivia*, L.) is somewhat doubtful. It is a widely-distributed plant, but is distinguished from the closely allied chicory or succory (*Cichorium intybus*, L.) chiefly by its

annual, or at most biennial character. Although distributed over the whole of Europe and Northern Africa (Egypt), its original plant may be sought for with less probability of success in the Mediterranean than in India, where *Cichorium cosnia*, Ham., is certainly the same plant, and met with about Patna and Kamaon, as well as in Nepal, growing wild. The varieties *divaricata, humilis*, and *nana* may be considered as the result of cultivation.

This plant, unknown to the early Greeks, is at present cultivated and eaten in Greece. The young shoots, as well as the leaves, are boiled and eaten with vinegar.

The chicory (*Cichorium intybus*, L., κιχωριον of Theophrastus) is a plant of as wide or even wider distribution than that just mentioned. The young leaves are used as food. Here and there only it is cultivated largely on account of its root, as, for instance, in Egypt, probably as far back as the time of Pliny. The dried root is frequently used in France and Germany as a substitute for or addition to coffee.

The samphire (*Crithmum maritimum*, L.) is a salad plant much prized in the entire East, as well as in Greece. It is cooked and used in sea voyages as an anti-scorbutic. Dioscorides mentions a κριθμον. Whether this plant is the above-named wild plant, or, as Landerer supposes, the latter is rather the κράμβη θαλασσια of Dioscorides, I will not here attempt to decide. Grecian fable narrates that the *Krambe* arose from the tears which Lycurgus, priest of Jupiter, shed when he beheld his slain child.

Bunias Erucago, L., *Senebiera coronopus*, Poir., and *Senebiera nilotica*, D C., are of less value. The first is used by the poor in Italy, the second in England, and the third in Egypt.

We may here mention a few plants allied to the above, such as *Zillia myagroides*, Forsk., (*Bunias spinosa*, L.), *Crambe maritima*, L., and *Crambe tataria*, Jacq. The former, occurring in the deserts of Egypt, furnishes only a poor dish on account of its spiny leaves, though it is used by the Arabians for lack of something better.

Crambe maritima, L., (*Sea kail*), growing upon the sandy shores of the East and North sea, and the Atlantic ocean, and of the Mediterranean sea, is more fitted for the purposes of nutriment. Even this, however, by the ancient Romans, was considered an indifferent article of food. When cultivated, and the young shoots are protected against the sun, it is like asparagus, and quite as good as this or cauliflower. The plant is chiefly cultivated in England.

Crambia tataria, Jacq., is a plant of the steppes of the region along the Lower Danube, Dnieper, and the Don. The root is fleshy and sweet, the thickness of a man's arm. It is eaten raw as a salad in Hungary as well as cooked, the same is the case with the young shoots of the stem. It is called *Tatar kenyer* (*Panis tataricus*), probably, because the Hungarians became acquainted with it in Tartary. In time of famine, it is used as bread in Hungary. It is probable that it was the *Chara caesaris* which the soldiers of Julius Cæsar used for bread.

The spinach (*Spinacia oleracea*, L.), a much-esteemed green vegetable, is probably native in the regions between Caucasus and the Persian Gulf, as also another species of the genus, *Spinacia tetrandria*.

The cultivation of this plant in Persia and Arabia, undoubtedly took place in the time of the Romans, and it was thence distributed over Europe and Eastern Asia. The Arabian name for spinach is *Isfânâdsch*, the Persian *Ispanj*, the Hindostan *Isfany*. Neither the Greeks nor Romans were acquainted with it. The Dutch spinach (*Spinacia glabra*, Mill.), is a variety of the common kind, produced in the course of cultivation. Of less importance are the green plants of the *Portulacca*, and numerous species of dock, such as *Rumex scutatus*, L., *R. acetosa*, L., and *R. patientia*, L.

The Portulacca or Purslane (*Portulacca oleracea*, L.), the ανδράχνη of Theophrastus and Dioscorides, is a very widely distributed plant of the Mediterranean, occurring everywhere, and readily entering the loose soil of the gardens. According to Landerer, it is used as a salad in Greece, with oil and vinegar, and is also kept for a longer period in salt-water and vinegar.

A much more extended use is made of a species of Purslane, the *Lewisia rediviva*, Pursh., growing in North America. This plant, which occurs in great abundance on the western side of the Rocky mountains, especially in the valley of Columbia, is collected by the natives, who carry its dried root with them on their wanderings, and use it cooked like arrow-root to very great advantage. A man in full health and vigor can be supported merely by the daily use of not more than two or three ounces.

The Canadian hunters and servants of the Hudsons' Bay Company, have long since learnt its use from the natives. (W. J. Hooker, Bot. Miscellany, vol. 1, p. 344.)

The different species of dock, rich in oxalate of lime, and therefore of an acid taste, are entirely wild plants raised here and there in gardens. The longest known, perhaps, is the common garden dock, *Rumex patientia*, L., which Pliny designated *Rumex sativus;* at the present day *R. scutatus* and *R. acetosa*, are more used than the first mentioned.

Here also may be mentioned the borage, (*Borago officinalis*,) which is characterized by the possession of a great amount of acetic, sulphuric, and nitric phosphoric salts, as well as of chloride of potassium, and, therefore, frequently used as a salad. The plant, native to the east, has been distributed throughout the whole of southern and middle Europe, even in the humblest gardens. It is also cultivated in North America and Chile.

The leaves of certain species of *Oxalis* furnish similar sourish, edible dishes, such as *Oxalis cernua*, Thunb., from the Cape of Good Hope, *Oxalis plumieri*, Jacq., from the Antilles, and *Oxalis zonata*, DC., in South Africa, cultivated at the present day in Belgium; *Oxalis crassicaulis*, Zucc., (*O. arracaha*, Don.), already mentioned on account of its nutritious tubers, and *Oxalis esculenta*, Hort. Berol., furnish an excellent dish from their leaves.

The Corchorus (*Corchorus olitorius*, L.) is a plant of the kitchen garden, the leaves of which are cooked like our spinach, and serve for food in the tropical regions of the earth. It is cultivated throughout the whole of Egypt to Cordova.

Other species of *Corchorus*, such as *C. tridens*, L., *C. acutangulus*,

Lam., *C. fruticulosus*, Vis., native in Sennaar and Cordova, are there used, as well as *Corchorus olitorius*.

There are still some other plants to be mentioned, which, although for the most part growing wild, or partly cultivated, are used as vegetables. Among these belong *Spilanthus oleraceus*, L., eaten as a salad on the Mascarenhas, in the East Indies, and South America, and called the cress, of Para, as well as *Spilanthus brasiliensis*, Spgl., applied to a similar purpose in Brazil.

A few *Cichoraceæ*, such as *Tragopogon porrifolius*, L., *Tr. pratensis*, L., *Leontodon taraxacum*, L. (dandelion), *Sonchus oleraceus*, L., &c., are hardly worth mentioning here, though their leaves are used, both raw and cooked, as greens. The latter is eaten as a salad in New Zealand and on the Friendly Islands.

The field or *Rapunsel* salad (*Valerianella olitoria*, Mönch,) is well known throughout the whole of Germany.

New Zealand has its spinach plant in *Tetragonia expansa*, Murr., which is not only distributed over the entire archipelago of the Pacific ocean and Japan, but has also been introduced into Europe. A second species, *Tetragonia halimifolia*, Forst., which is as good as the first, is, nevertheless, not used in New Zealand as on Tongatabu.

A good many acid vegetables are used as salad, as well as the sweetish and bitter-sweet. Among these belong some species of *Ranunculus* and the plants known as cresses in Europe and other parts of the world.

Besides the young leaves of *Ranunculus ficaria*, L., which are eaten here and there in Europe, another species of *Ranunculus* is brought to market in north Persia, *Ranunculus* (*Ficaria*) *edulis*, Boiss. It is called *morch-serdag* (egg yolk), on account of the yellow color of its flowers. The small tubers, together with the young stems and leaves of the blossoms, serve as food. With these, according to Th. Kotschy, there appears in the bazar in Teheran, as a vegetable, the *Uolag* of the Persians (*Allium latifolium*, Jaub. and Spach.) This grows on the Alps. The whole of the young plant is considered a delicacy, and is used as an addition to rice (in a pilau.) *Urtica dioica*, L., is used by the Northern Persians, as well as by the Europeans. The best known cress is the garden cress (*Lepidium sativum*, L.), which, originating in the East and Egypt, is cultivated in Europe. It is mentioned by Dioscorides under the name of *Κάρδαμον*. *Lepidium oleraceum*, Forst., is used in New Zealand as a spinach, particularly by seafarers, while *Lepidium piscidium*, Forst., of the lower oceanic islands is useless as food, on account of the great sharpness of the leaves, although it is employed in the capture of fish. *Iberis nudicaulis*, L., and *Cochlearia danica*, L., with the garden cresses, are similarly employed.

To these we may add the native *Cardamine amara*, L., and *C. pratensis*, L., as well as *C. nasturticioides*, Bertero, in Chile. *Nasturtium officinale*, R. Br., is much esteemed in France. It loses its bitter taste by cultivation. The Indian cress (*Nasturtium indicum*, D.) has also found its way into the gardens of France. Other cresses are furnished by *Tropæolum majus*, L., and *Tr. minus*, L., from Peru, as also by *Chimocarpus pentaphyllus*, Don, (*Tropæolum pentaphyllum*, Lam.), in Brazil and Chile.

The *Atripliceæ* and *Chenopodiceæ* are richer in esculent species than

the preceding. The *Orache* (*Atriplex hortensis*, L.), which is native in Tartary, has long ago been introduced as a kitchen vegetable in Europe, and has already, here and there, run wild. It was known to the Greeks as *Ατράφαξις* (Dioscorides). *Theligonum cynocrambe*, L., (*Κονοκράμβη*, Diosc.), indigenous to Europe, is also used here and there as a vegetable. The same is the case with *Chenopodium album*, L., *Ch. viride*, L., *Ch. hybridum*, L., *Ch. bonus henricus*, L., and *Ch. rubrum*, L.

The Strawberry spinach, or blite (*Blitum capitatum*, L., and *virgatum*, L.), is also more or less known. Even its insipid, strawberry-like fruit finds consumers.

Basella alba, L., is an East Indian spinach plant; and the roots of *Basella tuberosa*, H. B., serve as food in Colombia.

The species of *Amaranthus*, such as *Amaranthus ascendens*, Loisl., *A. prostratus*, Balb., and *A. sylvestris*, Desf., are used among us, although *Amaranthus polygonoides*, Lin., in Further India, is used only by the poor people. The younger shoots of the hop (*Humulus lupulus*, L.), likewise have a very limited application.

Some other plants of the Oceanic Islands and New Holland may be mentioned, especially in the southern part of the latter (Victoria), which are used as an antiscorbutic spinach. Doctor Müller mentions the following: *Tetragonia inermis*, *Trigonella suavissima*, *Tetragonella implexicoma*, and several species of *Cardamine*, also *Nasturtium terrestre*, and *Laurentia spicata*. Forster refers to the use of *Dracæna terminalis*, L., *Dracæena indivisa*, Forst., *Boerhavia erecta*, L., *Portulacca lutea*, Sol., and *Solanum viride*, Soland., upon the Society Islands and in New Zealand as kitchen vegetables.

The fruits of some of the *Solanaceæ* are of great importance as kitchen vegetables, especially the egg plant and the tomato plant. The former (*Solanum esculentum*, Dun.), (*S. melongena*, L., p. p.), is a plant of Southern Asia and the Indian Archipelago, of very ancient cultivation, although no longer met with there in a wild state. It came by way of the East to Europe, even in the time of the Romans, and has been distributed over its entire southern part. It is cultivated at the present day on the western coast of Africa and the Islands of Mauritius likewise, and has become an inhabitant of America since the eighteenth century.

To the Egg plant may be added the Tomato, (*Lycopersicum esculentum*, Mill.,) which is certainly an American plant, like most of the species of *Lycopersicum*. Although cultivated at present in the East Indies, its cultivation there dates only from the discovery of America.

The names, *Mala peruviana* and *Pomi del peru*, indicate still more decidedly its trans-Atlantic origin, and it is very probable that this plant was cultivated in Mexico at a very early period. At the present day the wild, original plant has disappeared from America, and even the form found on the Gallapagos seems to be only a stunted cultivated plant.

Two other plants, which in all probability belong to the western hemisphere, must not be passed over, although they have there a quite limited culinary application, they are the well-known *Phytolacca decandria*, Lin. (Poke berry), and *Ph. esculenta*, Van Houtte. The

former, originally from North America, its probable native land, has been distributed throughout Mexico, Brazil, the Sandwich and Atlantic Islands, and the region of the Mediterranean, even to Switzerland. It is used at the present day as a vegetable in the United States, and its young shoots are considered almost equal to spinach. It is doubtful whether *Ph. esculenta* is originally from Mexico or the East Indies; and it is only in more modern times that its leaves have been used as a spinach. (A. Braun on *Phytolacca esculenta*, a new edible plant. *Verhand. Gartenbau-Vereins*, xxi, 1, 1852.)

In conclusion, I may mention Asparagus, the Artichoke and the Gondelia, several species of *Malvaceæ*, the Caper, and the interesting Cabbage of Kerguelen's Land, and some other less known and less widely distributed vegetables.

There are several species of Asparagus belonging to the Mediterranean regions. Of these the true Asparagus (*Asparagus officinalis*, L.) furnishes a very excellent and much prized dish, and may, by cultivation, be brought to great perfection. It is a plant of the sea-shore and river-banks of Southern Europe, the Crimea, &c. It is not found either wild or cultivated in Greece. Only the young, juicy shoots are used, which, when cooked, are soft and sweetish, and have a characteristic taste from a peculiar principle, asparagin. It is raised extensively at the present day in North America.

The common Artichoke (*Cynara scolymus*, L.) is also a Mediterranean plant, and probably only a variety of *Cynara cardunculus*, L., produced by cultivation, which is native to the Mediterranean, the Islands of Greece, and to Sardinia. The *σκόλυμος* of Dioscorides is not this plant, but *Scolymus maculatus*, L., the young leaves of which, when cooked, serve as a vegetable. Only the undeveloped flower-head of the artichoke, especially its much thickened parts, is used, and it furnishes a much prized dish. This plant is only cultivated in Greece, although it is sometimes met with wild, escaped from gardens. The varieties produced by cultivation differ in having larger or smaller, round and oval, armed and unarmed heads.

Gondelia tournefortii, L., a thistle occurring abundantly in Palestine, is similar to the artichoke. The young plant, especially the thick stem, with the young and still undeveloped flower-heads, is brought to the market of Jerusalem under the name of *Cardi*, and sought after as a vegetable. (Kotschy.)

The unripe and still green capsule of the Okra (*Abelmoschus esculentus*, Guill. and Perrott, *Hibiscus esculentus*, L.) is rich in mucilage, and, therefore, very nutritious; when cooked, it is frequently used as a vegetable. It is native to tropical Africa, and has been distributed as a plant of cultivation from Chartum and Sennaar, and over Egypt to Palestine and Syria, and has become naturalized in America. Its Arabian name, according to Kotschy, is *Bamia;* the American, Gombo, Gobo, Ochro.

The unripe capsule of *Abelmoschus longifolius*, Medik, originally an American plant, at the present day replaces the preceding as an article of food in tropical Asia.

The flowers of *Abutilon esculentus*, St. Hil., (*Sida esculenta*, Steud.), which are used cooked in Brazil, are of less moment.

The following plants of the same family are used as vegetables in different places: *Hibiscus cannabinus*, L., of tropical Asia, at present cultivated in Senegal; *H. hirtus*, L., *H. micranthus*, L., *H. furcatus*, Roxb., and *H. radiatus*, Cav., used both in Bengal and the East Indies; *H. ficulneus*, L., cultivated in Egypt; *H. sabdariffa*, L., from Guinea, cultivated now in the East Indies and America; *H. digitatus*, Cav., from Guinea; and *H. maculatus*, Desf.

We may also mention here two other plants, *Malva verticillata*, L., in China, and *Malva rotundifolia*, L., used formerly as a vegetable in Europe, but at present more in China and Lower Egypt. Even Pythagoras thought much of this spinach; and among the Greeks, as well as among the Romans, it was at one time much esteemed. *Malve* and *Asphodell* were raised at Delos for the temple of Apollo, as a symbol of the first nourishment of man. At the present day the young shoots are used as a salad in Southern France and Italy.

Indifferent greens are furnished by the young shoots and leaves of some species of *Epilobium*, as *Epilobium angustifolium*, L., *Ep. latifolium*, L., *Ep. tetragonum*, L., &c., although sufficing for Northern Asia and Iceland. The same is the case in Iceland with the fleshy and saline leaves of *Arenaria peploides*, L., or Sandwort.

The preserved flower buds of the Caper bush (*Capparis spinosa*, L.) have received a wide distribution as a vegetable. It was known to the ancient Greeks, and the renowned Phyrne, at the first period of her residence in Athens, was a dealer in capers. The *Capparis herbacea*, Willd., and *C. rupestris*, Sibth. and Smith, are also used for the same purpose, as well as the *Spartium scoparium*, L., of Germany, and the *Zygophyllum fabago*, L., in Northern Africa and Syria.

In conclusion, I will mention a few other less widely distributed and little known green vegetables. Among these are *Euphorbia edulis*, Lour., of Cochin China; *E. pilulifera*, L., of the East Indies; *E. hirta*, L., *Plukenetia corniculata*, Sm., and *Apocynum indicum*, Lam., from the Moluccas; *Codiaeum chrysosticton*, Rumph., from Hither India; *Osyris japonica*, Thunb., from Japan. Also several species of *Cissus*, with their acid leaves, such as *Cissus latifolia*, Vahl., *C. quadrangularis*, L., and *C. crenata*, Vahl., of the East Indies; *C. rotundifolia*, Vahl., and *C. ternata*, Gmel., from Arabia; *Cleome cuneifolia*, Mühlb., and *Cl. speciosa*, H. B., the former of North, the latter of South America; *Gynandropsis pentaphylla*, DC., is used as a vegetable in the East and West Indies; *Cassia sophora*, L., and *Cassia esculenta*, Sweet, in Amboyna; *Bauhinia racemosa*, Vahl., in the East Indies; *B. lingua*, DC., on the Moluccas; *Trigonella esculenta*, Willd., in Bengal; and *Trygonella platycarpos*, L., in Siberia; *Bombax ceiba*, L., the Cotton tree, and *Bombax septenatum*, Jacq., of tropical America, and *Agave americana*, L., the leaves of which, when cooked, furnish a palatable and easily-digested food.

The cabbage of Kerguelen's Land (*Pringlea antiscorbutica*, R. Brown) is similar to our cabbage, in the shape and tendency of the leaves to form a head. It was first discovered by Cook, in his first voyage, and subsequently by Hooker, jr. It was found again in the Antarctic voyage of Captain Ross, and is used to great advantage as a pleasant anti-scorbutic by the sailors. It grows abundantly in every

part of the island to an elevation of one thousand four hundred feet, although particularly luxuriant and fitted for food as a sea-shore plant. The young leaves have the taste of cresses or mustard, only somewhat more pungent.

The preceding enumeration of nutrimentitious plants, which I have endeavored to make as complete as possible, omitting nothing of importance, will enable us to take a general survey of the vegetable substances used as food in different parts of the world. The number of different kinds of plants in this category amounts to nearly 800, which could be very considerably increased by adding those plants and vegetable substances which are only used here and there by man, and then chiefly when driven by hunger, such as the bark of trees, the acrid tubers and roots, the sprouts and leaves of various kinds of herbs, insipid and unpalatable fruits, &c., such, for instance, as the tubers of *Chaerophyllum bulbosum*, the plant of *Salicornia herbacea*, the fruits of the Haw, Bramble, and Sloe, of *Hippophaë rhamnoides*, the Beech-nut, &c.

If we bear in mind, however, that we are far from being acquainted with all the nutritious vegetable substances which are, or may be, drawn by man into the circle of his domestic economy, we may estimate the entire number of such species of plants at 1,000. Now, allowing, on an average only 10 to 12 varieties of cultivation to each species, we will have 10,000 different kinds available for his wants.

If we follow still further the facts mentioned above in detail, it is evident, as we remarked at the beginning, that the nutritious plants were originally distributed over the whole earth, and that the western hemisphere, as well as the eastern, had its peculiar vegetable products at the service of mankind. It will, however, be seen that the distribution of nutritious plants is by no means uniform, but that, on the contrary, certain parts of the earth are particularly favored, while in others they occur but sparsely, and in many regions are almost entirely wanting. This must necessarily have influenced very much the distribution of the human race over the earth, and its increase and accumulation in particular regions.

If we investigate this condition of things still further, by marking down upon a map of the earth the different nutrimentitious plants in their original localities, or in the ideal central point of their distribution, and represent the different varieties by particular symbols, we will obtain a very intelligible idea of the primitive condition of things, from which many important conclusions may be deduced.

If we now compare the two hemispheres, eastern and western, together, it will be seen that the eastern has a great preponderance over the western, so much so that, with the addition of New Holland and the islands of the Pacific ocean, it contains almost three times as many nutritious plants as the western. The following table will elucidate this more clearly:

Comparative table of the richness of the eastern and western hemispheres in nutritious plants.

Nutritious plants.	Total number of nutritious plants.	Number of nutritious plants.		
		In the eastern hemisphere.	In the western hemisphere.	In both hemispheres.
Amylacea, (starch plants)	237	191	45	1
Oleosa, (oil plants)	94	49	45	....
Dulcia, (sugar plants)	81	52	29	....
Acidula, (acid plants)	213	151	62	....
Salina, (saline plants)	145	122	23	....
Total	770	565	204	1

It is a remarkable fact, that nutritious plants are accumulated together in a linear direction, both upon the eastern as well as upon the western hemisphere. If we draw a line from the Moluccas to Ireland, by far the largest number and most important nutritious plants are seen to have originated along or in the direction of this line. Into this line fall the nutritious plants of the eastern archipelago, of Hither and Further India, of Nepal, Persia, Armenia, the Crimea, Greece, Italy, and Central Europe. The regions exterior to this belt of land furnish only a few species, and these mostly of little value, such as China, Japan, Central Asia, and the eastern and western coast lands of Africa. The coast of North Africa falls in part into this linear belt, ranging from southeast to northwest.

New Holland, New Guinea, &c., take their place as the most inhospitable portions of the earth.

The same law of distribution, although less prominently exhibited, exists in the western hemisphere. A similar line runs from Brazil, by way of Guyana, Peru, Ecuador, Central America, the West Indies, and Mexico, along which are accumulated by far the most important and influential nutritious plants. The species peculiar to North America, Chile, &c., are only of inconsiderable moment.

The result of our investigation is so remarkable that I cannot refrain from considering the *bromatorial* line as of the greatest importance in respect to the history of cultivation, and as a road which, while leading the wandering man along a sure path, renders it possible for him to accomplish the great problem of his existence here below; he advances towards greater perfection. In fact it is this and no other line, upon the extreme point of which the history of cultivation of the ancient world takes its starting point, and along which the nations penetrated victoriously, by degrees, into the heart of Europe.

How far this idea is to be applied to American humanity, I may not venture to assert, since at present only loose fragments are known to us

of the earlier history of cultivation in that country; nevertheless, such a connection with the line of vegetable nutriment seems to be clearly indicated.

By whatever path, and with whatever assistance, man may progress to a condition of high moral and physical development, this much is certain, that food, and particularly vegetable nutriment, must have the greatest influence upon the attainment of this great object.

ART OF GOVERNING THE SAP.

BY M. P. JOIGNEAUX, EDITOR IN CHIEF OF THE "FEUILLE DU CULTIVATEUR," PARIS.

[Translated by C. A. Alexander, of Washington, from the "Journal Mensual de l'Académie Nationale Agricole, Manufacturière, et Commerciale, Paris.]

A cultivator who gives himself no concern about the circulation of the sap in vegetables is not more in his place in the midst of the fields, than an engineer of a locomotive would be in his, who knew nothing of the properties of steam. The rejoinder, it is true, may be made that ignorance of physiological laws is very pardonable in the cultivator, since men of science are by no means of accord with regard to the course of the sap. In effect they range themselves in two different camps, one admitting the descent of the sap, the others denying it; but what imports to us the divergence of their hypothesis, if, as far as practice is concerned, they correspond to observed facts, and terminate in the same results?

Now, this is precisely what happens. Both equally satisfy us, and if we here adopt the theory of the descent of the sap, it is because it is the most widely diffused, and for no other reason.

We say then, the roots take up the liquid manure, which becomes sap, and ascends through the body of the plant, chiefly through the alburnum, is retarded awhile in the upper part, becomes modified and thickened, and then descends from the top towards the roots, depositing in its passage a new layer of alburnum. It is the blood, the life of vegetables.

It is the sap which makes the wood and the leaf—which makes also the fruit; the wood and the leaf, when it circulates in abundance and with force; the fruit, when its circulation is slackened, whether naturally, or in consequence of the obstacles we oppose to it. Knowing this, we comprehend, of course, that the art of governing the sap is of the greatest consequence to the cultivator. According as he governs it well or ill, it will give good or bad results. The pruning of trees, grafting, the culture of pot herbs, as well as culture on a larger scale, are subordinated to this principle.

Have we not slayers of trees, who end by killing outright their most robust specimens without obtaining any thing from them, while the skillful orchardist rears and keeps them long in a bearing condition.

Have we not kitchen gardeners who, so to speak, do what they please with their herbs, while others succeed only by chance, and can never be sure of anything? Why is this? Because the one has learned to manage the sap, the others know nothing about it.

Here and there, in professional books, we are supplied with judicious indications, but the writers do not attach themselves sufficiently to those little practical details in which consists the skill of the cultivator, but which escape the attention of scientists.

Now these little details interest us most; they form the principal object of the present article.

Let us commence with trees. When we have to do with subjects which are too vigorous, giving every thing in wood and nothing in fruit, we naturally infer that there is excess of health, and that it is proper to proceed with them as we would with sterile animals; in other words, let blood and put them on diet. Every enfeebled or suffering tree, plant, or animal is determined to the reproduction of itself. Hence we deal roughly with our barren trees; we make them suffer in different ways. Some retrench the roots, and thus cut off a portion of the channels which receive and distribute the sap; some drive nails into the trunk; some make holes with the gimblet as physicians puncture with the lancet. So much for the violent means.

The cultivators of the new school, if we may be allowed the expression, have recourse to procedures less energetic in form, but quite as sure in the result. To make a tree bear they content themselves with binding down the branches, with compressing the boughs against a wall or stake, with pinching the extremities. All this is perfectly known, but the reason of these little operations, it appears to us, is not so clearly comprehended.

The explanation, in a few words, is this: When you bend a branch down, you strangle, to some extent, the sap-bearing vessels at the point of curvature, at the same time that you withdraw the branch from the vertical direction which is favorable to the motions of the sap. Thus, this nutritive liquid no longer circulates so freely; there is a retardation of the developing process, and hence a determination to reproduction, that is, to fructification. When you tighten a bough against an espalier, you necessarily crowd the young alburnum, and thus choke the channels of the sap, and hence the same effects. When you pinch the end of a leaf-bud, you equally interfere with the flow of the nutritive juices, and disturb the functions of the tree, causing the bud to develop into a spur, which will produce flower-buds the next season; or by destroying a considerable number of leaf-buds, and thus checking the normal vegetation, you produce the same result with the buds that are left. And, as by thus depriving it of sap, you may convert a leaf-bud into a flower-bud, since the flower is in some sort but an abortive leaf, you may equally, by furnishing too much sap to the flower-buds, develop them into wood and leaves.

Would you have a proof? Cut close a subject charged with shoots, and you will see the greater part of those shoots changed into sterile branches, instead of fruitful ones.

When you practice close trimming, that is, when you remove much wood, the roots of the tree continue to supply sap, as if they had still

to nourish the parts cut away. This sap, being no longer entirely used up, since you have diminished the number of the branches which it fed, will turn aside, right and left, to form new wood, or else perish, for want of issues, under the bark. Three fourths of those who undertake the trimming of trees never think of this. They cut and prune at random, with very questionable benefit. But who is in fault? Those, undoubtedly, who will not give themselves the trouble to popularize the most elementary notions of arboriculture. Say, then, to our pruners: The amount of water, joined to the soluble matters of the soil, makes the amount of sap. We have more of it, therefore, in moist than in dry soils; more in crops watered than in those not watered; more in a damp than a dry climate; more in a tree grafted on a seedling with thirsty roots than in one grafted on the quince, with temperate roots. This being understood, it is clear that we ought to modify our practice in pruning, according to the nature of the subject and the climate. If there is no inconvenience in trimming a little close such trees or plants as have little vigor, there is much in pursuing the same course with those of great vigor. If it is easy to stop a gentle rivulet, and lead it aside in trenches and streamlets; it is difficult, on the other hand, to dam up a torrent.

When you have an impetuous sap, you will have no fruit; and it is not by cutting away largely that you will prevent this impetuosity of the sap. You will turn it aside, and nothing more. In such case, then, restrict yourself to light trimming, and endeavor to moderate the circulation by bending the boughs and branches from a vertical position, and rubbing off some of the buds. In this way, a certain amount of embarrassment and obstruction may be produced; the sap will moderate its course, and fructification will ensue. From this observation has arisen the idea of the annular incision, which consists in removing a ring of bark from the lower part of limbs, in order to make them produce fruit. By removing these rings, we produce difficulty and retard the descent of the sap. Both wood and fruit form more rapidly; but at this game we discount largely on the life of our trees, and alter the quality of their products.

What has been said of trees applies, necessarily, to flowers, to pot-herbs, and to plants of a higher culture. Would you have an instance? the small periwinkle, which, you know, at least by name, does not easily produce seed. Tournefort, one day, bethought himself of forcing it to do so, and succeeded, by placing a specimen of the plant in a pot, where its roots were straitened for want of room. Philip Miller, in England, took a different course with the same plant, and obtained satisfactory results, by moderately pinching the leaves at the base. In what concerns the kitchen-garden we should daily take account of the sap. Should our cabbages appear to grow too vigorously, so that their leaves seem more disposed to spread than form heads, it will be advisble to cleave their stalks through and through, and often three or four times during the course of their vegetation, as has occurred in our own practice during the past year, when, in vegetables of this species, a tendency to uncoif instead of heading manifested itself, in consequence of a superabundant flow of sap. The practice, too, of shortening the tops of our beans and peas, has it not, for its end, a slackening of the

circulation of the sap, thereby to procure a greater development and precocity for the pods? Undoubtedly; but this can only be on condition that the pinching of the beans and peas be judiciously calculated, for, if we practice it at random, we shall by no means obtain the desired result. They tell us to pinch our peas above the second flower, and rightly; but, as they tell us no more, some gardeners, and many amateurs, wait until the peas acquire four stages of flowers before they suppress two.

Thus, effectively, they do pinch above the second flower; only, by operating too late, they practice, without being aware of it, that short and close pruning which impels the sap to form rapidly new branches and leaves. Had they, on the contrary, removed but a slight portion of the stalk when it had just passed the second range of buds, the disposable sap would not have been considerable, would not have had the force to send out vigorous branches, and would have distributed itself among the neighboring flowers. As a general rule, then, suppressing the tops of plants is not, necessarily, conducive to fructification, except on condition that it be done in moderation. If you remove too much, you practice what is equivalent to close pruning in trees abounding in sap, and promote the production of leaves. It is not enough to trim; you must trim in due time and measure.

In cutting the vines of our gourds and melons (courges) we usually proceed without reason, and, of course, without success. We ought to cut above the fruit first formed, instead of leaving several to form with a view to making a choice. If it happens that the finest of the number is nearest the base, we are forced to remove a long piece of the vine, that is, to employ close pruning. We wish a very large specimen, and we operate so as to produce leaves and branches. In our own practice we prefer bruising the vine a little above the fruit and covering the bruised part with earth. In this way there is no complete suppression of the sap-bearing vessels, but only a slackening of the circulation.

In knotting the stalks of the onion and the garlic, do we not see an attempt at governing the sap? We thereby compel it to moderate its flow. So, too, in giving a twist to the seed-vessels of the beet and the purslaine, we hasten the maturing of the seeds, which, in France, would often take place too slowly, if the sap were allowed its free career. The same end is gained by straining the stems in two or three places against stakes in such a way as to strangle somewhat the channels of the nutritive juices. With a similar view, would it not be advisable to diminish the height of our kidney-beans, that, by obliging the stems to fall and curve backward, we might procure, not only an earlier, but, probably, also a more abundant product?

When the heads of cauliflowers attain the size of one's fist, we partially break the leaves which surround them, and superpose those leaves on the heads; then, in proportion as others are developed, we break the tops of these, also, until all are passed over, and the head of the plant is completely hidden. By merely doing this, the head is screened from the light, and kept white and tender.

Gardeners know this; but it may be doubted whether they generally know that such breaking of the leaves moderates the impetuosity of

the sap, and renders a large part of it disposable for the growth of the head, which is, consequently, better developed than under ordinary circumstances. The breaking is tantamount to what may be called long pruning in trees; while, in place of breaking, if we took the leaves away, we should have the equivalent of close or short pruning, and a result entirely opposite. The stalks would grow upward, and the heads would open to grow upward also. An example may be observed in the Island of Jersey, where the cabbages for feeding cattle attain an extraordinary height, simply in consequence of the daily gathering of the leaves nearest the base. If cultivators had an idea of the art of governing the sap, they would beware of cutting, either in whole or in part, the vines of their potatoes, in order to preserve them from disease, or to increase their size. When they cut them partially, the sap develops a multitude of small shoots, to the prejudice of the tubers; when they cut them entirely, they put forth no more shoots, but lose a prodigious quantity of sap, which moistens the ground and marks the place of each cluster. The tubers do not profit by it; the sole result being a great number of them, of the size of a hazel nut. We have, ourselves, made trial of both these kinds of close pruning, not, however, with the least expectation of benefit, but simply to have our mind disabused of all the nonsense which is emitted on the subject of agriculture. Reason condemned these experiments, and the result condemned them just the same. We approve of pinching the stalk of the potato, when the buttons disclose themselves, because it is a means of producing a pause in the rise of the sap, without much disturbance, and of determining the formation of tubers, which does not commence until after the complete development of the tops. But we greatly prefer bending to pinching. And why? In order to develop the underground branches or tubers.

By bending the branches above ground, we embarrass the flow of sap, and may be sure that a part of it will be employed in producing buds beneath ground. If you desire precocity, use this means: bend the stalk, and keep them in place with a lump of earth. It is as if you were told, whenever you wish a bud to develop itself quickly and surely, bend the bough a little above that bud, in order to retard the sap at that point. It is precisely what is done in the vineyard at Thomery to establish the second tier or line of an arbor or trellis. The curvature of the leading branch, above a bud of good appearance, develops that bud, and produces the desired result.

Enough has probably been said to evince the importance of the subject we are engaged with—a subject which we here only indicate, but which will furnish, we doubt not, sooner or later, the matter of some special treatise.

The art of governing the sap does not interest alone the gardener and the orchardist; it concerns, in an equal degree, agriculturists on a larger scale; for it is certainly with the sap that they are dealing when they mow crops which grow too vigorously, or pasture young meadows to make them thicken, or roll the cereals to suspend awhile their vegetation, or top their corn and beans, or pinch their tobacco. And, in these different cases, gross blunders may be committed in default of an intelligent apprehension of the reasons of the operation.

FARM JOURNALS.

BY JOHN L. GOW, OF WASHINGTON, PENNSYLVANIA.

It would seem to be demanded of the agriculturist, above all other professions and trades, that he should keep a daily record of facts immediately connected with his business, for various and important reasons.

The farmer's field is an extended one, full of varied and diversified knowledge, in itself continually suggestive of theories fruitful of experiment, and coextensive with the ages and development of man.

Natural philosophy and chemistry are essentially the handmaidens of agriculture. Who can estimate the value of the improved plow over the clumsy implement of the olden times; of the present reaper and mower, the thresher and cleaner, over those of fifty or a hundred years ago? Who can say what will be the result of future chemical discoveries? Yet, important as these matters are to the farmer, he cannot be expected to devote much time to them. It is rare, indeed, that he may become a chemist such as Liebig, but he should read "Liebig's Organic Chemistry, in its Application to Agriculture and to Physiology;" and then, by a record of his own experience, faithfully set down, he may be able not only to verify the truth of the experiments of others, and so improve himself, but also contribute his share to the advancement of the art and science of agriculture.

The advantages of daily journals have been declared by the practice of distinguished men, and, were it necessary, we might obtain many great names as authority for our suggestions; we shall refer to but one instance, that of our own Washington. It was not only in his first public employment, his embassy through the wilderness to French Creek, in his Braddock campaign, and during his glorious national career as commander-in-chief of the armies of the revolution, that his daily journals were accurate, useful, and interesting, but his methodical habits induced a continuous record of home concerns, his farm and plantation labor, the rotation of his fields and crops, and of all those things which he wished to remember, exhibiting the exactness as well as comprehensiveness of his mind, and his devotedness to system in all his private as well as public affairs. There is also an advantage in such records to the farmer's family, in a literary point of view. Young men, and even children, participating in them, become more and more interested in the matters of the farm, not only learning to write, (which of itself is important,) but at the same time to express any particular subject or event in proper ideas and words, thus establishing the character of business men, and acquiring that happy faculty which, with many, is the labor of years—to write clearly and forcibly. At first a duty and labor, this practice will soon become an easy habit, a source of gratification to the individual, and of interest to others.

Let us examine the subject more minutely. All our farmers are deeply interested in the subject of timber, cut or to be cut, for various

necessary and indispensable farm purposes. Timber at times is unexpectedly durable, and again as unaccountably perishable. As there is no effect without an adequate cause, we naturally seek that cause when we find remarkable differences. Is the durability of fencing materials produced by the time of cutting the timber, the state of the sap at the time, or the age and size of the tree? Has the moon's phase at the season of cutting anything to do with it? Is it a combination of any or all of these things, perhaps also united with the period of setting the posts or splitting the material? Or is there a more hidden cause producing the results? We should be likely to obtain satisfactory answers to these questions, did every farmer keep an accurate record of his timber-cutting, even to a tree, and the purpose for which it was required. The journal of a single farm, where much timber was used for thirty years, would throw great light upon the subject; and how much more satisfactory would be the result if every intelligent farmer were a contributor to the general information.

"On the score of economy," says the "Ohio Farmer," "much depends on the time trees are cut, whether to be used for timber or fuel. That which is cut from the middle of July to the last of August, will last twice as long for timber fences, and be worth fifty per cent. more for firewood, than that which is cut in the fall or winter. Cut in July or August, the last running of the sap, it seasons through quickly, becomes hard and firm, and will bear far more hard usage than that cut at any other season; seasoned immediately, it is not subject to be eaten by worms, nor destroyed by dry rot, but will remain sound for years."

Now all this may be true; but how many farmers can verify it by their experience as reliable?

Had we the recorded life-time experience even of twenty farmers—of every fence and building, every roof and sheep-shed, the aggregate, by comparison, would surely go far to settle all dispute upon this subject, and no doubt reveal important facts not generally known, as to fencing and carriage materials, utensils, barrels, hoop-poles, and the cutting of underbush.

Again, it is believed by many that the phases of the moon have a direct effect upon the results of spreading manure, setting fences, laying shingles, planting gardens, &c. Followers of these signs say that potatoes, carrots, beets, &c., productive from the root, should be deposited during the dark of the moon, and corn, beans, peas, melons, &c., growing above ground, in the light of that orb. They tell us, also, that beef and pork killed in a particular phase of the moon, will shrink in cooking, and otherwise will swell. Much of this, no doubt, is exceedingly ridiculous; but what is the true course for a wise man to pursue in regard to it?

> "There are more things in Heaven and earth, Horatio,
> Than are dreamed of in your philosophy."

Then, should not every farmer assist in verifying or disproving these assertions by his own notation of facts and results, and, if certain consequences do follow certain acts, instead of laughing at the signs, let us patiently explore the occult causes.

You have had, I will suppose, an unusual good crop of wheat. Your son, ten years after, desirous of like profit, inquires, "Did you manure the field? What kind of manure? What quantity? When spread? What time did you sow? What quantity of seed? What had been in the field before? What time did you harvest?" &c. You reply: "It was not written down, and all these things have escaped my memory."

Again, in elucidation of our subject, live stock is one of the means, and no inconsiderable one, in a farmer's available income. This, of course, includes neat cattle, horses, sheep, and swine. It is true, when we see the kind of cattle raised by some farmers, we should suppose the whole a matter of chance. Others, again, adopt a different view of the matter, and make money, too, by their views.

It is generally admitted that some breeds of neat cattle are preferable for form, some for milk, some for facility of fattening, some for docility, and some for the greatest combination of all these good points.

Let us suppose a farmer has a cow, (accidentally obtained,) extraordinary for quantity and quality of milk, beautiful in form and color, easily managed and milked, and readily fattened when no longer fit for the dairy, he would like another of equal properties. Now, were this a race-horse, or even a good common stallion, he could find out all about the pedigree of the animal without difficulty, but as it is nothing but a cow, although really ten times more important to the farmer than any race-horse that ever existed, he can discover no records on the subject, simply because farmers fail to note down every calf, bull, and cow, and the crossing of breeds, &c. Therefore, he must look to chance for the next cow to supply her place. If it be true that it costs no more to rear a good animal than a bad one, (and some say it costs less,) then should farmers know all about their stock, and keep a record of the kinds and crossings. These are but examples of many things equally important.

Still, it may be said by some that these are small matters, too minute to deserve the attention required. True, they are individually so, but our whole life is given in minutes, and the success of our lives and business is, in the main, dependent upon what appear, separately considered, to be trifles.

Again, we may be told, to journalize all the circumstances of a farm would be troublesome, the work of a lifetime. True, also; but remember you have a lifetime to do it in; and as to the trouble, it will only be one until habit makes it a pleasure, and its utility shall become so obvious as to prove a ten-fold recompense were it a continuous trouble.

Were our young farmers induced to observe, record, and study the affairs of the farm—were they to learn the true nature of the profession—how elevating, in a moral point of view, as a philosophical as well as a mechanical pursuit, and thus how dignified, how independent is farm labor, we should have fewer young men forsaking what they call "its drudgery" and "degradation" for the learned professions, thus throwing away the pearl of independence for the apparently easy life

of those who will tell you that success with them is toil unremitting, harrassing and oppressive, to which, in comparison, "holding the plow" is a holiday.

EXPERIMENTS ON PAW PAW SPIRITS.

[Extract of a letter from Dr. Charles T. Jackson.]

BOSTON, *October* 11, 1859.

I have completed my experiments on the paw paw spirit you sent me, and find that it is very easy to prepare a perfectly pure spirit from it by means of Atwood's patented process, viz: by the aid of the permanganate of potash and redistillation.

I have a sample put up to send, which you will find quite pure spirit, and free from all fusil oil and acids.

Mr. Atwood now resides at the Kerosene Oil Works, at Williamsburg, Long Island.

In the Smithsonian Reports on recent improvements in the arts, Booth & Morfitt, 1857, p. 182, you will find another method of depriving spirits of fusil oil, which is not subject to patent.

MODE OF PURIFYING ALCOHOL, ETC.

[Patented by Luther Atwood, of Boston, Massachusetts, August 23, 1853.]

The nature of the invention consists in "destroying, by chemical means, the fusil oil and odorous oils found present in alcohol and alcoholic spirits. These oils, derived from the various matters which have been fermented in obtaining the alcohol and alcoholic spirits, are more or less abundant in such manufacture, and are dsitinctive of the source from which each kind of alcohol or spirit was obtained. The principal oil has been long known by the name of fusil oil, or amylic alcohol, which is also mixed with other bodies, such as acetic acid and butyric acid, and ammonia, forming compounds more or less volatile. Besides these compounds, there are present in some alcoholic spirits volatile oils which are fragrant and give names to the spirits. These oils interfere with the uses of alcohol for many purposes; thus, in the preparation of chloroform, alcohol being used which contains fusil oil, there are a variety of products formed, having this oil as their bases, existing as ethers mixed with the chloroform, rendering it unpleasant or dangerous in its most important application. In the preparation of perfumes, alcohol containing fusil oil cannot be used as a solvent, from the action which the oil and its compounds exert on the essential oils used to give delicate odors. More generally, for officinal use, ordinary alcohol confers a repulsive odor when used for preparing tinctures and extracts. I am aware that alcohol has been partially purified by distillation and the use of charcoal and hypochlorite of lime, (Ca. O. $\times$ Cl. O.,) but the best samples contain notable proportions of fusil oil and ethers.

"To enable others skilled in the art to use my invention, I will proceed to describe my method, which is founded on the oxidating power exerted by manganic acid and permanganic acid on the oils and ethers found in alcohol. I take of finely ground manganese oxide three pounds, nitrate of potash or nitrate of soda five pounds, in a state of mixture, and slowly melt them in a crucible, continuing the heat until the melted mass passes from a fluid to a stiff, pasty mass.

"When cold, the mass must be powdered and kept dry for future use. It contains manganate of potash or soda, or gives permanganates of these bases, with excess of potash or soda and earthy impurities. Manganates and permanganates, however obtained, may also be used instead of the crude compound thus formed. In either case, I have found that these agents act on and destroy the oils present in common alcohol and alcoholic spirits rapidly, forming valerianic and other acids, which unite to the base of the manganate used, and may be removed. For every gallon of alcohol, of 85 or 90 per cent., I use two ounces of the manganic compound, dissolved in eight ounces of water, and add the solution to the alcohol while the whole is briskly agitated. This proportion is the average quantity required for common alcohol, but so much should be used as is sufficient to destroy the odor of the fusil oil, and the purified alcohol must then be distilled from the matters dissolved and suspended in it by gentle heat. In purifying alcoholic spirits of proof strength, such as rum, whisky, &c., I add the fine powder of the manganic compound in successive portions, agitating the whole rapidly, until the odor of the fusil oil disappears, and then distil the purified spirits. The manganic and permanganic acids, although combined with strong bases, are decomposed by the fusil and other oils, even when a great excess of alcohol is present. Pure alcohol is, on the contrary, slowly changed into acetic acid, and should an excess of the manganic compound be used, acetic acid would be produced, with loss of alcohol. The valerianic, butyric, and acetic acids, produced and previously existing, are left after the distillation combined with the potash and soda."

DISTILLED LIQUORS AND FUSIL OIL.

[From Booth & Morfitt, "On recent improvements in the Chemical Arts," page 182. Smithsonian Report.]

To free them readily from fusil oil, Peters recommends a hogshead, with a false bottom, to be half filled with well-ignited charcoal, the top of this to be strewed over with ten pounds of boneblack and five pounds of black oxyde of manganese, and the whole to be filled up with charcoal. The hogshead is to be filled with brandy, whisky, &c., which is to remain in it for three days, and then drawn off. That which first runs off cloudy is to be redistilled, but this operation will not be again required. The vessel thus prepared will last twelve to fifteen months.

VEGETABLE FIBER.

VEGETABLE FIBER, CONSIDERED WITH REFERENCE TO ITS STRUCTURE AND CHEMICAL PROPERTIES.

BY GEORGE C. SCHAEFFER, M. D.

Although the general structure of vegetable fiber has long been known, it is only within a few years that the rapid advances made in the science of vegetable anatomy, aided by improvements in the microscope, have cleared up much that was doubtful, and given us definite notions upon points which have a direct application to the processes of the arts. But few writers on vegetable anatomy have studied the subject with immediate reference to its technical applications, and it is only since the year 1852 that we have been furnished with minute and correct representations of the principal varieties of vegetable fiber.

The increasing want of paper-making material has stimulated the study of this subject, which, however, with few exceptions, has been attempted in the wrong direction, that is from a purely empirical point of view. The result has been, mainly, a revival of old and well-known processes, with immaterial alterations.

Our present object is to give an outline of the chemical properties and of the minute structure of vegetable fiber, a knowledge of which we consider as absolutely necessary before considering the technical or economical questions which may arise.

Owing, however, mainly to ignorance of the subject upon which we are about to treat, the economical questions themselves have been often misstated, and real advancement in the arts has been prevented by the unfavorable impression produced by the useless solution of such misstated questions. For instance, it is unwise and useless to attempt to supersede a well-established staple by another not fitted by nature to take its place. Long-continued agricultural and commercial relations cannot readily be overturned, even when they have not some well-founded reason for their continuance. The attempt to supersede cotton by the ultimate fiber of flax is a case in point. This project originated in England, more than a century ago, and, strangely enough, the effort to revive it has generally been prompted by purely social considerations. It requires but little knowledge of the respective structure of the two substances to understand that it is at least unprofitable to spoil good flax in order to make a poor imitation of cotton.

Again, many kinds of fiber might advantageously be used in cordage or in textile fabrics, and it must be evident that there would be no economy in breaking up such material at once to paper stuff, which might be made more readily and cheaply from the worn-out cordage or rags

from the same fiber. It is needless to multiply instances of this kind of misapplication. The true policy seems to be this: to introduce new materials to supply a demand for which they are directly fitted, and to leave existing materials to be used as before.

As questions which may be usefully considered, we will cite the following:

It is desirable to ascertain what fibers may be obtained from the dry regions of the Western plains, which, while favorable to such plants, are incapable of yielding any other profitable product of the soil.

Again, in some instances it may be found advantageous to increase the variety of fibrous substances produced in any given region, for circumstances which might prove disastrous to one crop might prove beneficial to another, and with this security the fortunes of whole districts would not be risked, as it were, upon the cast of a single die.

Another matter of great consequence in the economical consideration of fiber, is the difference between the supply from plants of spontaneous growth and from those which must be cultivated. Fibrous materials of spontaneous growth, for the most part, can only be brought to us from abroad; for, although the amount of uncultivated land in the United States may be large, it is not often that such lands abound in fibrous plants. The great plains of the West and the salt marshes of the seacoast will probably be found the only parts of our territory from which a spontaneous growth of fibrous material of any kind can be obtained in great quantity. Every now and then we hear that some one of our common weeds has been found to furnish a good material for paper stuff; but if we stop to estimate the quantity furnished by each plant, it will often appear that the product of a whole State would be required for one issue of our large daily or weekly papers. When we come to the cultivation of fibrous plants, the character and quantity of the product at once decide the question of profit. It is not every plant which is capable of regular cultivation, or of attaining, in a cultivated state, the luxuriance of its spontaneous growth. Many of our weeds owe their great abundance, in certain localities, to some peculiar ingredient or condition of the soil, which cannot be easily or economically produced at pleasure.

Such are some of the points of view from which the economical considerations in regard to fiber should be made.

THE VEGETABLE CELL.

Cellulose.—We now proceed to the examination of the structure of vegetable fiber, which, like every other part of the plant, is made up of *cells*, and upon the shape of these cells and their mode of attachment to each other, the character of the fiber depends. Of common fibers, cotton is the only one formed of a single cell. As the cell is the ultimate organic element of all fibers, the study of its nature becomes the foundation of all real knowledge of this subject.

Every living cell is an entirely closed bag, or vesicle, whose external wall is formed of a substance called *cellulose*, identical in composition with starch.

Test for cellulose.—Starch is readily recognized by the blue color produced with a solution of iodine. This color, however, is not formed

in cellulose by iodine alone, but the addition of sulphuric acid or of chloride of zinc readily brings it out. An exception to this reaction is found in the cells of some of the lower plants, which cannot, by any means, be made to give the blue color; nevertheless, analysis has shown that their chemical composition is identical with that of ordinary cellulose.

Chemical properties of cellulose.—The study of the chemical properties of the material of the cell wall is of the greatest importance to the arts. On the present occasion we must restrict ourselves to a few of the most striking, which, however, are those most often brought into use. For the demonstration of these properties we may employ clean cotton wool, old well-washed rags, of cotton or linen, or white paper made of cotton or linen, without the addition of mineral matter; materials which are so nearly pure cellulose that we may safely experiment upon them, instead of the substance more carefully prepared.

Although the more powerful chemical reagents have more or less action upon cellulose, one of its most remarkable properties is the resistance offered to the action of substances commonly considered as "corrosive."

Action of sulphuric acid.—The action of sulphuric acid (oil of vitriol) is remarkable, producing a series of changes of a very curious character. The first of these changes has already been referred to, as that which enables cellulose to give a blue color, with a solution of iodine, just as starch does. This change, however, is apparently but a mere transition to another condition, and the peculiar property only continues in the presence of the acid, for on the addition of water the blue color disappears, and cannot again be produced without a second treatment with acid.

If concentrated sulphuric acid is used in these experiments, the action becomes too violent to be observed in its successive stages; and if large quantities of material are employed, without the proper precautions, heat is produced, the cellulose is charred, and a new and different series of reactions commences.

When concentrated sulphuric acid, to which about one half its bulk of water has been added, is used, the cellulose swells, and is changed into a somewhat gelatinous mass, so that the individual cells become cemented or fused together. If the action is then arrested by the addition of water and some alkaline substance to neutralize the remaining acid, the cellulose is still found with the same chemical composition as before, although its physical properties are quite changed. Unsized paper subjected to such a treatment assumes, when dried, a parchment-like appearance, contracts in a remarkable degree, and no longer absorbs moisture, as the original paper did; in fact, except where holes occur, it has become water-proof. There will probably be many useful applications of this process, and it is to be regretted that the credit has been taken from the original discoverers, who long ago published the process and their investigations upon it, by those who have more recently chosen to re-discover what must have been known to every well-read chemist.

The prolonged action of strong sulphuric acid converts cellulose into *dextrine*, a substance soluble in water, and which is also obtained from starch. If water is added to the product, and the whole is boiled for some time, the dextrine is changed, by the further action of the acid,

into grape sugar, which can be obtained pure when the acid is precipitated by lime. As the whole change from cellulose to grape sugar involves merely the taking up of the elements of water, clean linen or cotton rags, by such a process, yield more than their own weight of sugar. The economy of this mode of manufacturing grape sugar is, at least, doubtful, although it has recently received much attention in Europe. Owing to the low sweetening power of this sugar, its chief use is for fermentation into spirit for distillation. Even the most common waste material, such as saw dust, can probably be more profitably worked up into certain kinds of paper, than converted into spirit.

Action of nitric acid.—Strong nitric acid, applied with proper precautions, does not decompose cellulose, but enters into combination with it in various proportions, in one of which it forms the now well-known *gun-cotton*, in which the original structure of the fiber is not visibly altered. This substance, from its solubility in a mixture of alcohol and ether, (*collodium,*) is highly valuable, affording on its evaporation a very thin and continuous water-proof film. The applications of this useful property are now numerous, in photography, in surgery, &c.

Nitric acid, by removing other substances which may be present, enables us often to bring out the ultimate structure of the cell wall, which would not otherwise be visible.

Action of caustic potash, or soda, &c.—Dilute solutions of caustic potash, or soda, do not materially alter pure cellulose, while they possess the valuable property of dissolving nearly all of the substances which are attached to or contained in the cell wall, excepting only the cellulose itself. In general, all solutions of salts having an alkaline reaction have more or less of this property. We shall show, further on, that the solvent power of alkaline solutions renders them almost indispensable in making paper from other material than rags.

Nitrogenous matter contained in the cell.—We have hitherto treated of the properties of pure cellulose, but it must not be imagined that the wall of the cell is wholly made up of this substance. Every living vegetable cell is lined with a coating (partly solid and partly soft, or even fluid) of a compound containing nitrogen, and liable, under the influence of heat and moisture, to enter into decomposition, which in turn changes the cellulose itself. As the parts containing the cells "ripen," and cease to grow, this substance disappears, wholly or in part. The heart wood of trees, the hairs on ripe seeds, &c., contain less of this matter than the sap-wood or the fibers of a plant taken at the time of active growth. The presence of such a ferment in freshly gathered fiber is not to be disregarded, although it has been scarcely noticed in technical works on the subject. The terms "gluten" and "mucilage" have been used very vaguely and inaccurately, to denote both the nitrogenous matter and other substances having quite different properties. The processes usually prescribed for the preparation of various common fibers, such as hemp and flax, being derived from long established experience, do, in fact, though not distinctively, refer to the presence of such a substance. But, when these methods are to be transferred to new materials, under quite different conditions, it becomes necessary that we should understand the reason why such processes have been introduced, and if these, as in the present instance,

are not generally known, it becomes the more important that they should be examined, in order that correct principles may guide new applications.

The presence of a ferment in fresh fiber is not without its use, for it aids in producing a partial decomposition in substances which it is desirable to remove, and which offer less resistance to such action than the cellulose itself. But an excess of this ferment will, unless it is removed or rendered inactive, endanger the strength of the product. With fibers drawn from plants in full activity of growth, in hot climates, this danger becomes serious, for under such circumstances, a few hours may do damage which elsewhere might require many days for its course. It must be remarked, too, that many, if not, indeed, most fibers, require for the attainment of the proper degree of softness and delicacy, to be gathered before the full maturity of the parts to which they belong. In proportion as this period is anticipated, will the nitrogenous or fermentiscible matter be present in greater quantity.

There are two different modes of dealing with this material. In the first place, it may be temporarily rendered inert by rapid drying. This plan is adopted in the milder climates, where such plants as flax and hemp, not very juicy at the time of maturity, are the usual fibrous products. The after treatment may then be commenced at pleasure, provided that the crop, in the meanwhile, is well guarded from moisture.

In the second place, this material may be removed, and at the same time produce the desired degree of fermentation, by the action of water, either while exposed to the air, as in the process of "dew-rotting," or when wholly immersed in water, as in "water-rotting." This latter process may be modified by using warm water, which hastens the desired action, leaving it, however, under the complete control of the operator. In this case, a thorough subsequent washing seems necessary to carry every vestige of the ferment. We need not dwell upon the merits claimed, respectively, for these different methods, our object simply being to point out the common principal upon which they depend with reference to the modifications required by new materials under new circumstances. We may remark, however, that very hot water would not answer, as it would, in great part, coagulate instead of dissolving the nitrogenous matter, and at the same time prevent the fermentation.

It is important to observe that we may entirely avoid the necessity for fermentation of any kind by a different mode of proceeding, the treatment with alkaline solutions, which we shall presently notice.

Incrusting matter.—The cell wall, besides being lined with the material just described, is also sometimes interpenetrated with another substance, called the *incrusting* or *lignifying matter*, and best seen in the "heart-wood" of trees, which differs from the "sap-wood" by the presence of this substance. It is this which gives the peculiar rigidity to the heart-wood, and which must be removed before the cells can be made pliable; but forming, as it does, a large percentage of such cells, we can easily understand the uneconomical nature of the processes which would attempt to convert hard-wood into useful fibre. The proper solvent for the incrusting matter is caustic alkali. A brown or

yellow color is, however, imparted by this reagent, and hence the bleaching action of chlorine must be superadded to remove traces of color caused by small remaining portions of the substance, which would not otherwise affect the useful properties of the fiber. Paper made from wood may frequently be detected by the yellow color caused by the action of alkaline substances.

To describe the properties of the matter in the cork-cells, and in the external coating of plants, would carry us far beyond the limits assigned to this article. It is sufficient to say that these can also be dissolved and removed by alkaline solutions.

Intercellular substance.—There is, however, one substance found in connection with most fibers, whose reactions are of the utmost importance; we refer to what is called the *intercellular substance*, or that which exists between the individual cells, and holds them together. Vegetable anatomists have not yet agreed as to its origin, although the most commonly received opinion is that this substance is derived from the altered remains of the original, or "mother" cells, in which the existing cells have been formed by subdivision. But, although there may be a difference of opinion as to the origin of the intercellular substance, there can be none as to its chemical properties. In general, it is readily attacked by the more powerful chemical agents, which have but little effect, or act but slowly, upon pure cellulose. But the most suitable solvent for this substance, in the case of nearly all fibers likely to prove useful, is an alkaline solution, which we have so often mentioned already as a solvent for nearly all matters found in fiber, except pure cellulose. The nature of the alkaline substance may be varied to suit the circumstances of the case—caustic potash, or soda, their carbonates, the lye from the ashes of plants, lime-water alone, or mixed with potash or soda, as well as other salts with an alkaline reaction, have all been used for the same end. The cost of these articles will, in general, determine which is to be employed, it being remembered, however, that caustic solutions have the most energetic action, and are therefore most economical when rapid and powerful effects are desired.

In every case where it is intended to separate the individual cells, whether for the purpose of imitating cotton by the long cells from certain fibers, such as flax, or for making paper from parts of plants having cells too short for textile purposes, some process embracing a treatment with an alkaline solution must be employed if economy is to be considered. Even in the case of fibrous bundles which are to be merely divided for textile purposes, and not decomposed into the ultimate cells, a treatment with a dilute alkaline solution may be advantageous. The processes of fermentation and of bleaching by chlorine contribute to the same end, but neither of these can be employed alone for that purpose without detriment to the strength of the product.

There is no part of the history of fibers which more strikingly illustrates the general want of knowledge of the subject than that which relates to the very process which we have been considering. A few years ago, the announcement that flax could be converted into a matter resembling cotton, was deemed by many the most remarkable novelty of the age, and there can be no doubt that much money was invested

in the proposed new manufacture. But Lady Moira, in the year 1775, treated flax by a method essentially the same as that just referred to, and specimens of the product are still in existence. The process itself, however, was not original with this lady, but dates back at least as far as 1747. So, too, with the similar use of alkaline solutions for the purpose of separating the cells of vegetable substances for paper making. We are informed that the attempt to use this process in the United States, in 1830, was stopped on the ground of the infringement of a patent granted in 1828. But the same thing had been patented in England, in 1801; and it is well known that the same method has been in use in China for centuries, accounts of it having been published by travelers at various times. The published list of English patents for paper making shows at least 50 which depend upon this method, either alone, or combined with bleaching.

Form of the cell.—Having examined the chemical properties of the material of the cell wall, and of the substances connected with it, we next proceed to the consideration of the form of the cell. A great variety of forms may be found even in a single plant, but it is only the elongated cell which is of much importance for fiber, whether it is used in bundles of a number combined together, as in flax, or singly, as in cotton, or broken up, as in paper stuff.

We may best represent to ourselves the form of such cells as they are found in the plant, by imagining a number of cylinders, with more or less pointed ends, placed together so as to "break joint," and then compressed, until the walls of adjoining cells are brought into complete contact, converting each cell from a cylinder into an irregular prism, with a cross section, showing a somewhat polygonal outline. Hairs, such as cotton, the down of the poplar, &c., not belonging to the solid parts of plants, are not always angular in their cross section.

Unequal thickening of the cell wall.—Spiral arrangement.—Vegetable fibers, however, would be very limited in their applications, if each individual cell had a wall of equal thickness throughout; they would then resemble rods, or bundles of rods, which would tend to untwist when twisted, and which, having no hold upon each other, could not easily be submitted to the operation of spinning. In fact, the hairs of many seeds, such as the "silk cotton" of South America, and the "down" or "silk" of many of our native plants, although apparently of great value, from the length of the staple and from their soft and silky character, have proved useless for all ordinary purposes, on account of their imperfectly cylindrical shape and the uniform thickness of their walls.

But, in reality, the growth in thickness of the cellulose is in very few cases quite uniform, the additions which are made on the inside of the cell being confined, mainly, to certain determined lines, or spaces The figures produced by these unequal depositions generally enable us to recognize, under the microscope, each particular kind of fibre, even in the most minute fragments. But the remarkable peculiarity of most vegetable fibers is, that the unequal depositions tend to take a spiral direction, and consequently, when dried and somewhat shrunken, the cells, from rods, become transformed into screws, often, indeed, of very few turns and very fine threads, but still having sufficient inequality of surface to adapt them to the operation of spinning. If the

cross section of the cell is angular, or if, as is sometimes the case, these angles are produced so as to form longitudinal ribs, it can easily be understood that, from the action above described, the result will be a screw of very sharp thread. An instance of this kind has occurred to us, in examining a very remarkable Japanese paper. The fragments, or even entire cells in this paper, were of unusual length, and evidently contributed to the great strength of the paper by their angular and somewhat spiral ribs.

Even in fibers which do not in their ordinary condition show this spiral arrangement, it may often be made manifest by the application of chemical reagents. In the early delineations of fiber, as seen under the microscope, the point of which we are treating seems to have been almost entirely overlooked, but its importance is undoubted, not only as a means of recognizing different kinds of fiber, but as affording a good general idea of the peculiar properties of any one kind.

Pith cells.—We have hitherto treated only of elongated cells; but there are others quite different in shape, being nearly as broad as they are long, or, if elongated, still not pointed. In these, too, the contact of the cells generally produces planes, so that each one has as many facets as it has points of contact with neighboring cells. This kind of tissue has its walls, in most cases, but little thickened, and from the great number of joints has but little strength in any direction. Such cells form the substance which we call "pith," and, for convenience sake, will hereafter be designated as *pith cells.*

The well-known Chinese pith paper is almost the only instance of the application of such a tissue to what might be called fibrous uses. By a spiral cut the pith is unrolled, from the circumference inward, into a sheet, which, by a pressure slightly crushing its cells, is made permanently flat. The extreme fragility of pith paper is a proof of the general inapplicability of this tissue to the purposes of which we are treating. But, though of itself useless, the relations of pith to fibers is of some importance, for in many cases it surrounds and isolates from other structures that which we call fiber, and by the portions of it which remain adhering we may often be able to determine the precise origin of a given specimen. Paper made from the grasses, straw, &c., can always be recognized in this way.

The removal of pith cells is one of the principal objects to be accomplished by fermentation, treatment with alkaline solutions, or the mechanical processes used in the preparation of fibrous material.

Ducts.—There is also another kind of cells, which, contributing little or nothing to the strength of fiber, by their relative position to the elongated cells, materially influence the character of the compound fibers in which they are found. These are the *ducts*, which are formed originally of round or prismatic cells, of some length, placed one over the other, and separated by end partitions, which are not exactly transverse, but slightly inclined from the horizontal. As the cells attain a certain degree of maturity, these partitions become perforated, and each series is then formed into a continuous tube.

The walls of the ducts are variously marked: sometimes the deposit inside is in the form of separate rings, sometimes in that of spirals, and in other cases again pits, arranged in spirals, are found in the otherwise uniformly thickened cell wall. The diameter of the ducts

is greater than that of any other form of cell, a matter of no little influence in certain compound fibers.

The characteristic markings of the ducts, and their mode of arrangement, are of service in enabling us to determine the plant from which they are obtained.

GROUPING OF CELLS IN FIBER.

Position of fibers in the plant.—The peculiar mode of grouping of the cells which constitute fiber, and their position in the plant, must next receive our attention.

There are two great divisions of the vegetable kingdom, marked both by internal and external characters, which enable the botanist to decide, with the utmost readiness, upon the proper position of any plant; but as these characters depend upon essential differences in the mode of growth, the two divisions are found to differ widely in the kind of fiber produced, and in its position in the plant.

Position of fiber in endogens.—The first division is formed by what botanists call *endogens*, or inside-growers. This division is best known to us in its herbaceous forms, such as the grasses, including the cereals, sugar-cane, and the common cane; also, the lily, the cat-brier, and, in short, all plants whose leaves have parallel veins. In the south, it is represented by the yucca, or thread-and-needle plant, the agave, or false aloe, and by the palmetto, which, like the palms of the tropics, is furnished with a more or less hard or woody stem. These plants do not form a regular bark, show no rings of annual growth, and do not increase by continued additions on the outside of the stem, as is the case with the woods common in our climate. Such plants show, on a cross section, no lines, but a multitude of dots, without any definite arrangement. In a longitudinal section, it is found that these dots are the sections of long bundles of cells, running lengthwise through the plant. The substance in which the bundles are imbedded is entirely made up of short pith cells, and the whole growth of the fiber, which represents the wood of other plants, is made either by their increase in length or by the introduction of new branches of the bundles among those already formed. As the stems of such plants grow old, not being provided with the means of increasing on their circumference, they become more and more dense from the pressure of the bundles in the interior. In this condition, the trunks of endogens resemble our ordinary woods in solidity, but are not well adapted to furnish fiber, which is generally obtained from the herbaceous stalks and the leaves of plants in this division.

Structure of the fibrous bundles of endogens.—The structure of the fiber of endogens, as developed under the microscope, is worthy of a somewhat extended description. The cross section of the bundles is sometimes nearly circular in outline, more commonly oval, but often rather egg-shaped, or even heart-shaped; and in some cases it is angular, rather than rounded. Near the center of the figure, but on one side of it, large openings will be noticed; these are the sections of the ducts, which we have described above. Very commonly, there are three of these, but the number may vary; the arrangement, however, in most cases, being such as to approach the form of a crescent. Besides

the large ducts, there are smaller ones, the peculiarities of whose structure we need not stop to describe. Within the crescent thus formed will be found a group of small cells concerned in the active growth of the plant, and representing those cells which, in ordinary woods, are found between the sap-wood and the bark, and which form the tissue called by botanists the *cambium*. This is generally too delicate in its structure to resist the ordinary treatment to which fibers are subjected, and moreover contains a large portion of nitrogenous or fermentiscible matter. It therefore not only disappears itself in the usual treatment, but also furnishes a material which favors the separation of the remaining cells of the bundle.

Surrounding the different kinds of cell which have been enumerated, we find the true elongated cells, which form the essential constituents of all useful fiber. In some cases these are found in greatest number at the opposite ends of the section, especially when its outline is much elongated; but in a state of maturity, the whole of the bundle is inclosed by thickened cells of this kind.

Although the most common forms of the fibrous bundles of endogens are such as we have just described, there are many deviations from them, some of which have no little influence upon the character of the fiber. In the case of thin leaves of plants in this division, we have found that those bundles which come up to the surface depart from the ordinary mode of structure, being, in general, more ribbon-shaped and round in outline.

Changes produced in the preparation of fiber from endogens.—We have sought in vain for any account of the character of the fiber which ordinary processes produce from such bundles. Our own examination of a large collection of specimens leads to the following views: The ducts, large and small, and the cambium, disappear, while only the elongated cells remain. Two different conditions may then be attained. In one, the hardened, elongated cells form a continuous boundary to the other tissues. In this case the result will be a collapsed tube, nearly round, when the outer cells are much hardened, as in some of the palms, or more or less flattened, when the external rows of cells are softer, and the ducts, and other evanescent tissues on the inside, form a large portion of the section of the bundle. The twist, or wind, of such fibers will depend partly upon the spiral structure in each cell, but still more upon the mode of arrangement of the individual cells in the bundle. In the other case, the exterior row of cells is not sufficiently hardened, or does not form a continuous boundary to the bundle, and then, when the interior portions give way, the groups of elongated cells open into a ribbon, which often has a tendency to separate into two parts.

As a general rule, the round or collapsed tubes are derived from the older portions of the trunks, or thick leaves—the ribbons from the thin leaves of endogenous plants. The respective diameters of such bundles of fiber will have their influence upon the processes to which they may be subjected, and in most cases, from their length, measured by feet and inches, they are best adapted to manufacture of cordage, unless divided by a further treatment into portions, which are, when spun, fitted for the finer textile purposes.

Structure of strips from the leaves and stalks of endogens.—There is one case in which the structure of the fibers from endogens is more complex than that before described. We refer to the palms, grasses, &c., in which strips from the leaves or stalks are used, when, in addition to the proper fibrous bundles, we have also the external cells, or cuticle, which, with its indurated and glazed surface, adds to the strength, while it detracts from the fineness and pliability of the fiber produced. Material of this kind is best adapted to the uses about to be noticed.

Textile fabrics from untwisted fiber of endogens.—While the great length of the individual bundles of fibers of endogens best fits them for spinning, or twisting into cordage, it also permits of a textile use without twisting, which has numerous useful applications. Straw, or its substitutes, furnish the best instance of untwisted endogenous fiber, made into useful fabrics by plaiting. Again, in some kinds of eastern matting, we find the "filling" made up of the untwisted parts of leaves or stalks, while the "chain" is formed from a twisted fiber of a different character. On the other hand we find, in a remarkably strong fabric from Madagascar, strips, apparently from the leaf of a palm, woven into cloth, in which both the chain and the filling are formed from the same material, the continuity of each being made by knotting or tying the ends of the long strips as originally obtained from the palm; the evidence of the mode of union being the knots appearing at intervals upon the surface of the cloth.

The fabric above described was contributed, through the Smithsonian Institution, by a merchant well known for his devotion to science in all departments, and is highly interesting even in a purely commercial point of view. There were two different specimens, one quite coarse and the other of a finer texture, seeming to differ only by the degree of subdivision of the leaf. Both of the specimens, but more especially the finer of the two, seemed admirably fitted, by their peculiar stiffness, to fill all the requisites of the material known as "crinoline." If the actual commercial wants of the day had been thoroughly understood and acted upon, we should have had, but not for the first time, the demands of the fashions of an advanced civilization best answered by a supply of material from barbarous nations. Recent developments in the world of fashion show that, in a transition state, this kind of fabric may yet be of universal prevalence. We dwell upon this point for the purpose of showing that the varying and apparently arbitrary demands of commerce may often be supplied in the most unexpected manner, and from the most distant sources.

But by far the most curious fabric of this kind is the *piña,* (pronounced "pinya,") which, although made in the East, is produced from the fiber of the pine-apple, indigenous to the New World. Under the microscope this remarkable cloth, fine in texture, and unrivaled by any similar product of the vegetable kingdom, shows woven but untwisted filaments of the finest character; and the wonder is how such a fabric could be formed. But this difficulty disappears when we are informed that the fibers produced by the usual treatment of the pine-apple fibers are glued together by their ends, so as to form a con-

tinuous line. Instead of visible knots, we have here what are called *invisible knots*, which give to the piña its peculiarly even character.

We have dwelt at length upon the fabrics above described for the purpose of showing that, in a country where labor is cheap, productions may be afforded at moderate cost, which could not possibly be made under other circumstances at a price which would not prove at all remunerative. We must, therefore, learn that the cheap products of the dense population of the East cannot be economically imitated on our own soil, unless machinery be made to take the place of manual labor, which, in the cases last named, cannot be done, in so far as we are now informed.

Treatment of endogenous fibers.—The treatment to which endogenous fibers must be subjected will at once be evident from what has been said above. The bundles lie isolated in a mass of short and generally tender pith cells. In some cases a purely mechanical process is sufficient to remove the useless short cells from the fiber. Mere scraping, in some instances, answers the desired end; sometimes the action of rollers is best adapted to the purpose. But a complete separation of the adhering remains of short cells cannot be attained by merely mechanical treatment; maceration in water, or some degree of fermentation, is needed when we wish to obtain a neat and clean fiber. After this, some mechanical process will be found most effectual in removing the partially detached fragments of tissues which do not add to the strength of the fibre.

Endogenous fibers of the United States.—Within the bounds of the United States there are few native endogenous plants capable of affording long fiber except in the South and Southwest. The grasses and sedges, the most abundant representatives of this division of the vegetable kingdom, are, unless in the case of plaits for straw or "Leghorn," seldom worth much as materials for long fiber, although they may be useful for the manufacture of paper. But the yuccas and palmetto of the South, and the agaves of the Southwest, are capable of furnishing long fiber of excellent quality. In fact, the arid plains of the southwestern portion of the United States seem capable of no vegetable production more valuable than fibers of this class. From private information we learn that much material of this kind is carried into Mexico, while little is known in the United States of plants which, even in their spontaneous growth, might contribute largely to our industrial resources.

Value of microscopic examination of endogens.—The point upon which we are most anxious to insist, in this direction, is, that an accurate knowledge of the chemical properties and of the structure of endogenous fibres, as developed by the microscope, will enable us to determine, in the most expeditious manner, the nature of the process by which the best kinds of product may be obtained from any given plant. For instance, from a microscopic examination we may be able at once to show what kind of treatment will resolve the bundles of fiber into slightly collapsed tubes, or into ribbons. In fact, the peculiar conditions required by the manufacturer are not yet sufficiently well known; and it is only by the light afforded by accurate scientific

determinations that the consumer and producer can be mutually benefited.

Fiber of exogens—bast cells and their mode of growth.—In the second grand division of the vegetable kingdom the mode of growth is totally different from that last described. Here the wood cells, tolerably short, intermixed with ducts, (except in the case of the pine family,) and with pith cells, form the mass of the stem or trunk, which increases only by new growth on its outside, and hence such plants are called *exogens* or outside growers. None of the tissues of the trunk afford long fibers, which are only found in the bark, and are commonly known as *bast* cells. They are often of great length, but little hardened, and form, with the exception of cotton, the most valuable fibers of commerce produced in temperate climates.

The mere indication however that exogens increase by growth on their circumference gives no idea of the way in which the long fibers increase, and we must go somewhat into detail to make this subject clear. If we examine the branch of a linden, of the present year's growth, we will find a central pith, and rows of pith cells diverging from this, (medullary rays,) which are continued into the bark. These divergent rays are not continuous in a vertical direction, and it is readily seen that, if they were, woods of all kinds would easily be separated into wedges, meeting at the center of the trunk. Longitudinal, or rather tangential sections show that the medullary rays are merely bundles of no very great depth in the direction of the axis of the plants, and that they alternate or break joint with each other, so that the wood cells, in spite of such interruption, give a continuous support to any end pressure, even when not exactly perpendicular.

The "cambium," or tissue, which is directly concerned in the multiplication of cells, lies on the outside of the wood and inside of the bark. The new wood cells are added on a constantly increasing circumference, but the bast cells are formed in the same place; so that, while the wood increases on the end of wedges pointing to the center of the plant, the bast cells are increased at the same place, and therefore in wedges in the bark, which are increasing inwardly. If the wood, therefore, is exogenous, and grows outwardly, the bast cells are endogenous, or increase inwardly. This distinction between the mode of growth of the wood and of the bark is of the utmost importance, and, as far as fibres are concerned, is the clue to their whole history in this branch of the vegetable kingdom.

It would carry us far beyond our limits if we should describe the peculiarities of the mode of growth of the bast in different plants. It will be sufficient to say that the medullary rays are prolonged into the bark in all cases, and that the bast is formed between their ends, conforming exactly to them, so that its fibers, winding first to one side and then to the other, seem to interlace, while in reality they merely leave a space for the ends of the medullary rays. This structure may be readily demonstrated in the "lace bark" which is sometimes used to tie bundles of cigars. Although apparently interlacing, we can easily show that the fibres only approach and recede from each other. It is true that the rows of bast cells are not always continuous from the wood toward the outside of the bark, and that pith cells interveno

between them; but the effect of this is, simply to produce successive layers of the bast, all having the same character.

In barks of great age, it must be evident that the bast cells constantly increasing on the inside, and therefore, forming wedge-shaped bundles, with the bases inward, must in time produce a disturbance and even a rupture of the outside of the compound structure known as bark. This is generally the case: the bark gradually splits on the outside, and, in some plants, the dead bast cells even hang in strips from the trunk. But it is only in a few cases that this evident separation of the long bast cells takes place in plants which furnish useful long fiber. If the external portion of the bark, which constitutes an air and water-tight covering to the tissues beneath, has disappeared, the bast cells are exposed to the atmospheric agents, and undergo a change by oxydation, which not only impairs their original softness, but darkens their color to a hue which is with difficulty removed by bleaching agents, producing, in this respect, the same effect which always follows an imperfect preparation of fiber when its exposure to the air has been unduly prolonged.

We cannot, therefore, except for coarse cordage or for paper, employ the external, weather-stained bast; it is only the inner and unaltered layers which can be used for the finest purposes; and it then becomes a question of the rapidity of growth of the bast, in each particular plant, to determine how long it should be allowed to stand before taking the crop. In trees which attain a great size, the cutting down of the tree and stripping of the bark would involve so much labor that a limit would soon be reached beyond which the economical production of fiber would be impossible. It is true that in semi-civilized countries, where labor is cheap, materials may be obtained at a low price, which could not in other hands pay for the cost of the labor expended upon them. But it must also be remembered that unless the population is dense, as in India or in China, the supply cannot be kept up, even at a cheap rate of labor. Many disappointments, caused by undue hopes excited by plants which really do yield an abundance of fiber, can be traced to the simple neglect of the economical question just mentioned.

But, in fact, the chief product of bast, of any consequence in commerce, from trees of any size, is that known by the name of "bass," or "bast," obtained from the bark of the linden, in Prussia; and, in this case, the strips, of a convenient size, are directly interwoven, and do not undergo any process like that of spinning. The bast-mats thus made are well known to the gardener, both as a cheap and excellent covering for many purposes, and as affording a substitute for twine—remarkably well adapted to horticultural use. It is not at all likely that, for many years, the conditions of labor in the United States will permit anything like a profitable employment of our own species of linden in a like manner.

The cost of stripping the bark from exogens will, therefore, at once set a limit to the production of fiber from such plants; and this limit alone would long since have diminished our supplies but for other conditions which we next propose to develop.

Bast of herbaceous plants.—Many plants of this great division of the vegetable kingdom are herbaceous; that is, grow with but little

strength to the stem for one year, and then die down to the ground, or altogether. Even perennial plants of warmer climates may, in the milder regions of the temperate zones, become annuals. In the case of true annuals, there is no need for any great hardening of the woody tissues of the stem, as the sole end to be attained is a sufficient support for the plant until it flowers and the seed ripens. Herbaceous stems, which die down to the ground each year, are evidently designed for a similar, restricted end. In the case of perennials, which, in other climates might become, at length, woody shrubs, a single year's growth is not enough to allow of much induration of the wood cells; and hence they approach nearly to the condition of true annuals, although the tendency to produce firm wood is constantly shown. If, under either of these three heads, a plant is found which furnishes a long and useful bast, a common and well-known mode of treatment can be economically employed for the separation of the fiber. The plant is exposed to the action of air and moisture, with more or less of fermentation, until the different tissues become separated, and even until the different cells are loosened in their adhesion. The crude product is then subjected to the operation of "breaking," by which the harder and shorter woody fibers are broken, and in part removed, while the pliability of the bast allows it to pass through the treatment without injury. At the same time, the short and more tender cells are also removed, the latter stages of the process differing for different plants, all contribute to the complete separation of the remains of the adherent and useless tissues.

Two things, then, must concur to make a useful fibrous plant, for not only must the bast be long, pliant, and in bundles of the proper size, but the wood which is to be rejected must be brittle, with short cells, not much hardened or not strongly adhering together. Flax and hemp are, in our own country, the best specimens of these favorable conditions, but we have other plants nearly, if not quite as well adapted to the manufacture of useful fiber; and other countries show that nature has not been stinted in her supply of materials capable of meeting one of the first wants of mankind.

Influence of culture upon fibrous exogens.—If we have been successful in communicating a clear idea of these conditions, the ready conclusion must be that differences in degree, even in the same plant, under varying circumstances, must frequently occur; the wood may become harder and greater in amount, the bast weaker and less in quantity, and the necessary inference might be drawn that judgment and skill in the culture of the plants would favorably modify these conditions. Experience, in advance of anything like an accurate knowledge of plant structure, has shown that this is true, at least for our common fibrous crops. Single stalks of hemp or other fibrous plants allowed to grow at a distance from each other, or from other plants, would furnish but sorry specimens of fiber, if, when collected, they were managed as the results of an ordinary crop. A single plant invariably shows a hard woody stem, and a coarse fiber in the bark. But when a number of plants are grown in a small space, every one knows that they grow longer, and are more slender than when left to themselves. In this way the strength of the wood is much dimin-

ished, and the fiber of the bark, if less abundant, is finer and possibly longer. If the plant has a tendency to branch, this is prevented, and the neat preparation of fiber from a branching stem is no easy matter.

The close cultivation of cotton, okra, and other plants, which we are accustomed to see separated from each other, would probably show a fiber in the bark far more capable of treatment by the ordinary processes than would be suspected by most persons. A knowledge of correct principles is here of the greatest advantage, when new materials are concerned. The influence of soils and the details of the treatment of the crop are beyond the bounds of this article.

Fiber of the Mallow family.—A mere enumeration of the exogenous fibrous plants would alone form a small volume. We can here only notice, in a general way, some of the most remarkable families, or individual plants, to which attention might profitably be directed. The Mallow family is noted in all parts of the world for the production of fine fiber in the bark. A great number of malvaceous plants are natives of the United States; many of these, in the southwest, are popularly unknown, but a trial of their capacities will be a great public service. Our great staple, the common cotton, is obtained from the wool upon the seed, and is therefore not a bark fiber; but as the cotton is a malvaceous plant, its bark might be supposed to be a good fiber. This has been verified, as shown by an article in the Patent Office Report for 1854. But the cotton, in other regions, grows to a tree, and if we allow it to produce seeds abundantly, as it must do, to afford an abundant crop of the wool or hair which clothes the seeds, the stem will, as a matter of course, become hard and woody. No one can imagine that there would be profit in cultivating the cotton for the fiber of the bark, at the sacrifice of the more manageable and valuable product attached to its fruit. But the okra, which is only raised for its esculent, immature seed-vessels, seems much better adapted to profitable employment in this direction. The fineness and abundance as well as the strength of the fiber are such as to render experiments with this plant, under close cultivation, highly desirable. From specimens in our own collection, it would seem probable that the quantity of fiber on a single plant might, under favorable circumstances, be sufficient to pay for the process of stripping by hand.

Fibers of the Nettle family.—The Nettle family, in all of its subdivisions, produces plants abounding in excellent fiber. One division, the Hemp sub-family, contains not only the well-known hemp itself, but the hop, which, although not cultivated for its fiber, has been tried for paper making. The Bread-fruit, or Mulberry sub-family, includes not only the different species of mulberry, but the common paper mulberry, and this, although not a native of the United States, grows readily everywhere. All of these are fibrous plants, but the last is the most useful.

Our Osage orange of the South, has not, as far as we are aware, been examined for its fiber, which, however, may yet be found useful.

The paper mulberry is cultivated over so large a portion of the earth's surface that it is somewhat remarkable that no attempt has ever been made in the United States to obtain fiber from it. In the Pacific islands this plant furnishes the paper-like cloth known as *tapa*.

In Japan, China, and elsewhere, it is used for making paper of superior quality. For fibrous purposes the paper mulberry should be cultivated so as to give long and slender shoots, after the manner of the osier or basket willow. Whether the bark could be removed by breaking instead of stripping, is a point upon which we have no information.

If ever the culture of silk should be extended in this country, the remains of the ordinary mulberry shoots might be used in the same manner just described as applicable to the paper mulberry.

The Nettle family proper is, in all parts of the world, productive of valuable fibrous plants. The most remarkable of these, the far-famed "China grass," has been described by us in the Patent Office Report for 1855, where it will be seen that the individual cells of the fiber exceed in length those known in any other plant. We have an indigenous species of Bœhmeria, the genus to which the China grass belongs, but this seems never to have been examined. Of our species of true nettle, (Urtica,) one, which is an introduced plant, has been employed in Europe. In the Western States, before the cultivation of the soil for anything but articles of food had been commenced, nettles of spontaneous growth were used as a substitute for flax, and we have often seen persons who remembered the time when shirts were made from nettles. We cannot learn whether any attempts have ever been made to cultivate these plants, nor do we know even the particular species which have been used.

Fibers of the Dog-bane family.—The Dog-bane family, in various parts of the world, is represented by plants remarkable for their fiber. Two species of *Apocynium* in the United States are rather well known, both for their medicinal properties and for their fiber. One of these, the *A. cannabinum*, or "Indian hemp," has its properties represented both by its botanical and its common name. Experiments on the cultivation of this plant are desirable.

Fibers of the Milkweed family.—Nearly allied to this last is the Milkweed family, best known by the different species of milkweed, or silkweed, (*Asclepias.*) The commonest and best known of these, the *A. cornuti*, (the *A. syriaca* of Linnæus,) often attracts attention by the abundant and beautiful "silk" upon the seed contained in its pods. This substance, however, has but few useful applications, for the cells are cylindrical and perfectly smooth and even in their walls; they are therefore incapable of taking any strong hold upon each other, either in paper or in textile fabrics. We do not mean to say that paper cannot be made from this substance, for there is a specimen of such paper in the curious work of Dr. J. C. Schaeffer, published in 1765, and even there it is mentioned as having been made a few years before by a correspondent of the author. An examination of this specimen, and the care which has been taken to preserve it from injury, shows that it cannot possess any great strength. It is barely possible that the action of nitric acid, or of other reagents which tend to develop the spiral structure in the plant cell, might improve the properties of this silk, although it hardly seems probable that the result would pay for the cost and trouble. Used as wadding, or floss, this substance may find direct employment, for articles of great beauty have often been made from it.

This plant has been made the subject of numerous communications to the Patent Office, generally by persons who have been actuated by the promising appearance of the silk. Some of the correspondents have desired to obtain a monopoly of the use of the plant for fibrous purposes, an end, it is hardly necessary to say, which the patent laws of the United States cannot accomplish. In some cases, however, correspondents, with a laudable desire for the general good, have called attention to it, under the erroneous impression that its useful properties were unknown. In fact, there is no one of our native plants which more curiously illustrates the general want of knowledge of our own products, which are, however, much better known and appreciated elsewhere; and, indeed, it can hardly be possible that any other case can be found of a similar character.

The name given by Linnæus to the common silkweed implies that it is a native of Syria, but according to our best botanists, this is not correct, for it has been ascertained to be "a native of this country only," (Gray). Yet this plant is cultivated in Europe; directions for its treatment can be found in German works, and we have seen specimens of the fiber prepared in Russia. Still, we know of but two notices of the bast, or bark fiber, of the Asclepias in American books. One of these is a notice of a patent granted in 1834, to Mrs. Margaret Gerrish; the other, an article in a much older publication, which shows that the true value of the plant was well understood even in the last century, and that its product was even an article of commerce. Unfortunately, we have not now access to the work last mentioned. It is plain, however, that the early knowledge of the fiber of the silkweek caused its introduction into Europe, where it has finally become a cultivated plant, while in its native country but little is known of its true value.

The history and an accurate description of the silkweed as a fibrous plant would alone form a highly instructive and valuable contribution to the knowledge of our native products.

The bast of the Asclepias furnishes a fine, long, and glossy fiber. We have verified this fact, in Kentucky, comparing the silkweed with the hemp, produced under the best system of culture. In this case, however, the native fiber was taken in winter from the decayed stalks, as they stood upon the ground where they grew without culture, while the hemp had not only been cultivated but treated afterward with the usual care. The fiber of the silkweek was nearly if not quite as strong as that of the hemp, but apparently finer and more glossy, while the quantity from a single stalk of each was nearly the same.

The culture of this plant is said to be without difficulty, and almost every one has noticed it growing, even upon poor soils. As it is a perennial, with strong roots, successive crops might, for a long time, be obtained from one sowing of the seeds or planting of the roots.

We wish it to be understood that it is not our object to exaggerate the value of the milkweed, but merely to excite an interest in the culture of a neglected native plant, which has in other countries received more attention than it has in our own. The fiber may be ranked between that of flax and of hemp, for textile purposes, while, if the

commercial demand for such uses were not sufficient, the cultivation for paper stuff, at once, might prove remunerative.

Fibrous plants not necessarily an exhausting crop.—In this connection we must mention one important matter relating to the culture of fibrous plants, many of which are supposed to exhaust the soil in a peculiar manner. It is true that such plants do often withdraw from the soil a large portion of soluble inorganic matter, which, if the crop were wholly carried off, would soon leave the soil incapable of sustaining a future crop of the same plant. But the fiber itself contains only a small percentage of these ingredients, which are directly measured by the ash. This is found in greatest quantity in the refuse of the crop. If, then, the rotting is done upon the same field which produced the plant, many of the soluble matters are at once restored to the soil from which they had been drawn. The leaves fall upon the ground, and carry back other mineral ingredients, and finally the refuse, after breaking, restores most of the remainder. Hence, if the ashes of the refuse are returned to the soil, there is but little left which must artificially be added to restore its original condition. These relations of the fiber to the plant from which it is drawn are too little known, and yet a want of such knowledge is frequently the cause of wholly unnecessary exhaustion of the soil.

Structure of bast cells.—We have given no minute account of the characters of bast, as the varieties are almost endless. As a general rule, the cell-walls are rather thick, showing the spiral structure, while the cells are longer than in any other vegetable tissue, and, in some cases, are not simple, but more or less branching. The thickened walls are scarcely ever filled with the rigid, incrusting matter found in the wood-cells of the stem; hence the greater pliability of the bast. The bundles of fiber in their section, although commonly wedge-shaped, are sometimes semi-cylindrical, but the intervention of rows of pith-cells, which disappear in preparing the fiber, in most instances leaves the bast in flat ribbons. All of these peculiarities may, at once, be readily determined by a microscopic examination, aided by the proper chemical tests.

We have said but little of the wood of exogens, because it rarely furnishes a useful fiber, except for the purpose of paper-making, upon which we are about to make a few remarks.

Cotton, structure of the cell.—Cotton we have only mentioned incidentally, because it does not form a constituent of any of the tissues which we have described, being made up, as has been stated, of the hairs, each one a single cell upon the seeds of the plant. The great value of cotton, and that which distinguishes it from all known hairs of plants, is the spiral structure of the cell-wall, recognized not only in the finer markings upon the fiber, but by the form of the entire cell, which may best be represented as a tube flattened until the opposite sides nearly or quite meet, but with this flattening not in one place, but in a spiral direction. Every degree of twist may be found in cotton, some fibers being scarcely more than ribbons, while others are very well described as screws. Upon this character, combined with the fineness and length of the cells, the value of the fiber mainly depends. In previous articles in the Patent Office Reports we have

furnished information upon this subject, but much yet remains to be determined, which can only be done after a more careful study of a great variety of specimens, and under favorable circumstances, which have not yet occurred to any one capable of such an investigation.

FIBROUS MATERIALS FOR PAPER.

Historical notice.—The complaint that rags alone were not sufficient to supply the wants of the paper-maker dates back at least one hundred years; and that this complaint has not been without foundation is shown by the constant increase in the price of rags. Improvements in the process of manufacture, and the introduction of new material, have, at intervals, delayed this increase in price, but only for a short time. The demand for new material for paper-making has led to many investigations, the most remarkable of which are those detailed in the work of Dr. J. C. Schaeffer, before mentioned. This book is illustrated by a large number of specimens of paper made from different substances in the house of the author. In making his paper the old-fashioned pounding machine was used, and the material was only reduced to the condition of "half stuff," the specimens are therefore rather coarse. Chlorine, our great modern bleaching agent, being unknown at that time, the paper presents the natural hue of the material. In many of the specimens there is a mixture with rags, but some of the most curious have no such addition. The leaves, stems, and hairs of various plants, moss, algæ, shavings and saw-dust of woods of different kinds, wasp-nests, old shingles, potato peelings, and apparently every accessible source of vegetable fiber, were experimented upon, and specimens of the paper furnished; in one case the mineral kingdom is made to contribute paper from asbestus.

The publication of this work seems to have given some stimulus to this new branch of industry, and new materials have gradually come into use. The process of bleaching by chlorine, or its compounds, gave a new impetus, as it brought into use serviceable fibers which, from their color, had previously been inapplicable to the manufacture of white paper. From time to time other works with specimens have appeared, but the modes of treatment were essentially the same as those introduced about the end of the last century, and these, we have already shown, with the exception of bleaching by chlorine, had been known for centuries in the East. The latest work of consequence, with actual specimens, was published by L. Piette in 1838.

Piette mainly confines himself to straw; but, making use of chemical agents, he has produced paper of superior quality. The specimens are particularly valuable, as they show, not only paper from each material unmixed, but from various intermixtures of the materials with each other and with rags. A very slight examination of Piette's specimens will be enough to satisfy any one that good, strong, white, and smooth paper may be made of straw, the productions of the different kinds, however, having peculiarities. The author does not seem to have a very high opinion of paper made from wood, and gives, as a specimen of the best mode of using this material, a very neat *shaving* which, at first sight, looks like a delicately tinted paper. Strange as

Piette's suggestions may appear, we have in our collection a very elegant visiting card, printed in Paris, not upon paper, but upon a thin and uniform shaving of wood. This use of wood seems destined to extend the meaning of the word "shingle," from the sign to the card.*

As an evidence of the supply of paper stuff from other substances than rags, as far as Europe is concerned, we may state, from good authority, that single establishments use for such purpose straw, wood, or even stable manures to the extent of hundreds of tons annually.

The manufacture of paper from straw, wood, &c., in the United States, originated between 1828 and 1830. The first article made, in any quantity, was a coarse and rather brittle wrapping-paper, from straw, but an article from wood, good enough to use for newspapers, was made about the same time. This branch of industry has, however, made but little progress, except for coarser purposes, although fair white paper has been made from both straw and wood. It is to be remarked that waste rope and bagging, and fibers of all kinds, enter largely into the manufacture of the best kinds of paper; the modes of treatment in all cases being essentially the same, the source of supply being determined by the cost.

Condition of fiber, as found in paper.—Although the manufacture of paper from various materials has, so far as the processes are concerned, attained a high state of advancement, the minute study of the condition of the fiber in paper seems to have received scarcely any attention until a quite recent date. So far as we can learn, the first investigation on this subject was announced by Reissek, in a communication to the Royal Academy of Sciences in Vienna, in 1845, but not published until 1852. This article is illustrated by several figures, which correctly represent fiber, mainly flax, as found in papers of different qualities. In the next year Schacht published a work, in which the fiber from paper made of various materials is well illustrated. From these drawings, and from the descriptions of the authors, it is easy to understand the condition to which paper stuff must be reduced, and if our previous account of the structure of the vegetable cell is remembered, we may, in a few words, convey a correct idea of the nature and condition of the fiber in paper, even without the aid of drawings.

It will not be necessary, in this place, to describe the engine by which rags, &c., are reduced to pulp for paper; it is sufficient to say that by its action the fiber is *broken*, not *cut*, into fragments, the length of which is but a very small fraction of an inch. If the fiber could be divided by a clean cut, no paper could be made from the resulting pulp, for it is the rough and jagged ends of the fragments which give the peculiar felting property to ordinary paper stuff. Instead of "fiber," in this paragraph, we might rather have said "cells," for, in reality, the peculiar kind of fracture of which we have been speaking depends upon the breaking up of the cells; a mere separation of the cells from each other would give, as must be evident, but a use-

* Since this was written we have learned that "chip" cards have been introduced into the United States, and are now on sale at the stores.

less product. The material introduced into the engine is, with few exceptions, a compound fiber, and as there is not a perfect separation of the cells laterally, however much they may be broken in their length, we have used the word "fiber" advisedly.

If the walls of the cell were of uniform thickness, there would be no reason why they should break with any other than an even and nearly transverse fracture; but if we remember the constant tendency to a spiral direction in the thickening of the cell wall, we can readily understand that the operation of the paper engine will be to *fray* the broken ends of the cells into strips, which will take a more or less spiral direction, when they are free to take the most natural position. The paper pulp being suspended in water, having nearly its own specific gravity, these frayed ends will readily resume the original turn or twist which they had as thickened portions of the cell wall. Hence the felting property of paper stuff, which, by the intertwining of even the smallest fragments of a cell, allows the whole mass, on drying, to form a continuous and coherent sheet. The introduction of size, as a matter of course, increases the cohesion, but a consideration of this part of paper manufacture, and its further consequences, would lead us beyond our limits.

We have spoken of the cells as broken, but it must be evident, from the variety of directions in which they are presented to the beating surfaces in the engine, that they are often split; but this does not alter the condition of things, for the direction of the split will be the same with that of the frayed ends. The interlacing properties, derived from the character of the outside surface of the cell, need not be insisted upon here, since we have already said enough upon this point.

The fineness and smoothness of the paper from any given material depends upon the degree of comminution of the fiber, which may be carried so far as to leave nothing but split and frayed fragments, scarcely a single cell retaining its original diameter. The strength of the paper, of course, diminishes with such a treatment, a fine and yet strong fabric being only produced by a due mixture of portions of fibre representing the two extremes of subdivision. The best condition would be attained when each fragment, as far as possible, exemplified the two extremes—that is, when portions of cells, retaining their original diameter, would be furnished with a long and abundant fringe of frayed ends. The experience and skill of the paper-maker has, in a general way, led to the attainment of desired results, with old and well-known material, but this has been done in ignorance of the precise conditions upon which these results depend, and for any new material, time and expense only can be employed, to acquire an equally good skill and experience. But by a knowledge of the precise character of the material, obtained from microscopic examination, and by the aid of a few reagents, a sound basis may be laid for intelligent experiment, with a saving of both time and trouble.

Microscopic examination of wood for paper stuff.—As an illustration of our assertion, let us suppose that a certain wood is proposed as a material for the paper-maker. The thinnest possible cross section is examined under the microscope, and the figure as well as the thickness of the wood cells, noted. The specimen is next treated with solution

of iodine, and then with chloride of zinc, or dilute sulphuric acid, and again observed. The portions colored blue will show how much of the cell wall retains its original character, and those which are reddish-brown show the infiltration and deposit of the incrusting matter. A similar section is next to be treated in the same way, after having been boiled in a solution of caustic potash, or soda. The increased portion colored blue and the diminution of the red will show how much of the useless incrusting matter has been removed, and by repeating the experiment we can soon obtain an approximate estimation of the amount of and the cost of removing the useless ingredients. We can also obtain a correct idea of the outline of the section of the individual cells, whether angular, rounded, or ribbed, points which we have before shown are of no little value. A small portion of a very thin shaving of the wood, in a longitudinal direction, is, after boiling in an alkaline solution, again examined. If the cells are not well separated, we may resort to some of the more powerful reagents, or if the shaving is, microscopically speaking, thin enough, we may use needles to tear the cells apart. We then observe the length of the individual cells, and, above all, the markings upon them, which show the uniformity or spiral arrangement of the thickened portions. We are then prepared to give, in accordance with what has been said above, a good approximate estimate of the value of the wood as a material for paper-making.

We have selected wood as an illustration, because we have not, as yet, particularly described its structure, and because two important points, the length of the cells and the quantity of incrusting matter, are brought under consideration. Almost any substance, otherwise useful as fiber, may be converted into paper, yet the relative values of different materials may be determined by the methods above described.

Structure of wood cells.—As a general rule, the cells of wood are short, with pointed ends, and may sometimes be even too short for paper stuff. Interspersed among the true wood cells, we always find the ducts, described above, with the single exception of the pine family. which may always be recognized by the "disks," with a "pore" in their center, found generally on the radial surface of the cells. In the *Coniferæ*, or pines, we often find an abundance of resin; this, like the incrusting matter, must be removed by an alkaline solution.

In the Pine family, which most largely contributes wood for the manufacture of paper, we find notable differences in the character of the cells, and are thus able, even in fossil woods, to determine the exact character of the plant. Without any trial, we can say that the yew (*Taxus*,) and its ally *Torreya*, would furnish a material for paper, with peculiar properties, derived from the remarkable spiral thickening of the cells. Unfortunately, trees of these genera are not abundant enough to warrant even an experimental examination.

In some woods, in addition to the medullary rays, made up of what we have called pith cells, there is another tissue of similar cells, which cannot be expected to add to the strength of paper stuff.

Economy of using wood for paper stuff.—It is, therefore, easy to determine what sort of wood is best adapted to paper-making, and we have in our collection specimens which show that the range of choice is by

no means limited. But another question of economy arises, which has excited much inquiry and invention, namely, the most advantageous method of reducing solid wood to the requisite degree of fineness, for subsequent treatment. A good rule, equally applicable to the manures of the farmer and to the supply of the paper-making material, we would give in a few words: *use what others waste.* If the thousands of tons of saw-dust, annually wasted at the different saw-mills in the country, could be collected in one place, there would be no want of material for paper of a certain quality. But as this cannot be done, we may fairly suppose that, in some localities, an abundant supply may be maintained; if not, resort must be had, provided that the wood itself is cheap enough, to mechanical means of disintegration, which are beyond the bounds of our present inquiry.

When grass, straw, or herbaceous plants are used for making paper, a new matter for consideration arises. The great abundance of pith cells in these is wholly, or in part, removed, and passes off as waste, either in the treatment with alkaline solutions, or from the paper engine. The exact weight of solid matter in such materials cannot, therefore, be reproduced as paper, and the loss must be accompanied by a corresponding cost in the process which causes the loss. In such cases, again, a microscopical examination of the material may afford an approximate estimate of its value.

We would like, in this connection, to refer to a process of paper-making in some respects quite different from that which is used among us, yet in the East has made paper a substitute for cloth and for other fabrics, which we manufacture at a great cost. But, without space to describe even the specimens illustrative of this point, we must, for the present, abstain from entering upon new matter.

In conclusion, we have to say that the foregoing is to be regarded as the mere outline or sketch of the research of several years, which might, if expanded into details, have filled a goodly volume. Our endeavor has been to give a general view of the subject, trusting it may prove interesting, and even profitable, to the reader, furnishing at the same time sufficient indications of the course to be pursued if he should be desirous of further information.

In general, we have abstained from quoting authorities as out of place in an article of this kind. But no statement has been made which cannot be substantiated by sufficient authority, or by our own demonstration. Considered as a mere sketch of what might have been said, we must beg those who are well informed upon any one particular point to remember that, if we had noticed everything by the way, our article would have increased to a volume, and to believe that the omissions which may be criticised by them are regretted by us.

IMPORTANCE OF SALT IN AGRICULTURE.

If we should ask why so enormous a quantity of this inestimable gift of salt is distributed throughout the earth; why three fourths of the surface of the planet designed for the home of man is covered with

it? the answer would be: In order to preserve the work of Nature, to enable man the more readily to sustain himself, and to make him wealthier and better. It has become an indispensable condition for the existence of man, and his civilization. In all organic beings we meet with two processes—that of life and that of decomposition—the latter beginning its full activity after the former has achieved its end, at the moment when organic beings are dissolved into those constituents from which the plant was formed and nourished.

If, however, we intend to check, or, at least, delay decomposition, we must employ acids, for we know that the Creator formed of the sea-salt a mighty barrier against the immeasurable mass of water becoming putrid; we know that our stocks of flesh, grease, &c., are preserved by the application of salt; that cabbage-water, acids in general, and kitchen-salt are the means employed by the agriculturist against septic diseases in our domestic animals, and against diseases of the mouth and feet. The separation of milk and deposit of meat will be increased by the application of salt, thus forming an essential means for the promotion of cattle-raising. By the application of salt, the fruits, especially wine, will become much better; and even the ancients were in the habit of throwing salt on their grounds, their vineyards, and fruit trees. Agricultural chemistry informs us that the simplest combinations through which nourishment is conveyed to plants consist in acids, alkalies, and alkaline substances. Animal chemistry shows that free muriatic acid and kitchen-salt form the principal constituents of the contents of the stomach.

In a French prize paper, by Dr. Desaive, on the manifold advantages of the use of salt in agriculture, the following results have been laid down by the celebrated French veterinary surgeon, Grogniez:

Common salt serves as a preventive of the fermentation and heating of hay, which has been heaped up in large stacks during wet weather. Forty quintals of hay require fifteen pounds of salt, to be strewn among it in alternate layers.

This effect is much better shown in straw, which, if intended to be used as fodder, by being moistened with salt-water, may be preserved for a long time, when it can be given to cattle instead of hay—a method in use among the ancients.

Leaves of trees, when put in ditches with salt, may be prevented for a long time from putrefactive fermentation, and will even make good forage. Intelligent farmers of the Mont d' Orlyonais are in the habit of thus preserving their vine leaves as fodder for goats.

Fodder of inferior quality, for instance, straw, or other kinds, soaked and bleached by rain and sun, cured too late, or become woody, may be rendered more palatable and easy of digestion by being salted. A pound of salt in three quarts of water is required for a quintal of bad hay.

The sharp taste which the milk of cows usually assumes in consequence of beets, turnips, and white cabbage being continually fed to them, can be removed by salting those vegetables.

In Flanders, common salt is strewn on new and wet oats, to be fed to horses, and, thus prepared, will not be dangerous to the animals. The same application may also be made to hay newly harvested, to

prevent injuries when it may become necessary to feed such hay, the moisture of which has not been fully evaporated.

Though the bad qualities of dusty, muddy, or moldy fodder, after having been washed and threshed, are not entirely removed, yet, by giving a sprinkling of salt-water, they will be diminished to a considerable degree. This fact will be of advantage to the farmer whenever he may be in want of appropriate fodder.

By means of salt, such water as otherwise could not be used for cattle for drinking, will be rendered proper.

The great advantages to be derived from common salt with regard to the health of cattle have been clearly shown by many experiments made by that learned and celebrated agriculturist of Alsace, M. Boussingault. Cattle, by being fed with salt, receive a soft and glossy skin, their digestion and appetite are in good order, and they increase in flesh and strength. Cows thus fed yield much milk, while those treated otherwise have dull skins, with rough hairs, exhibit less appetite, produce a smaller amount of flesh, and yield not only an inferior quantity, but also quality, of milk.

Manure from cattle fed with salted fodder is also of a better quality.

Finally, manuring with salt will banish mosses and hurtful parasitical plants from meadows.

SOME HINTS UPON FARM HOUSES.

(BY SAMUEL D. BACKUS, ARCHITECT, NEW YORK.)

An intelligent traveler, in passing through our country, will observe among neighboring agriculturists, a great similarity in the modes of cultivation adopted, in the cattle reared, the horses driven, the vehicles, and farm implements used, the machines employed, the crops raised, the barns erected, and the general means and manner of pursuing their avocations, each following what is shown to be a good example, and all agreeing in the course which their combined experience has shown to be advantageous. But it is a frequent occasion of wonder that a class so quick to perceive, so shrewd in judging, and so prompt to adopt any improvement which may lighten their labors, increase their profits, or permanently benefit their lands, should, in their own dwellings, exhibit so great a diversity of style, construction, and real value. There is not merely such a wholesome variety as would arise from peculiarity of situation or disposition, but sometimes a difference so entire as to show that neighboring builders, who, upon other matters seem to think alike, have either disagreed radically respecting the purposes for which their dwellings were to be erected, or have failed to give those purposes a due consideration.

With all this dissimilarity of design, there are very few American dwellings, except some of the log-houses reared for temporary use by

settlers in the forests, which do not afford more of physical comfort than the residences of the same class of people in any other country.

Within a few years past, the attention of the higher classes in Great Britain has been turned to the subject, and model cottages for agricultural laborers have been built, under the auspices of committees and societies, in various parts of the United Kingdom, the descriptions of which show that what are deemed essential conveniences in every house here are there regarded as rare improvements.*

But, notwithstanding this superiority, the residences of American farmers and planters are, as a class, far less valuable than, with information and facilities of construction, they might be made. Some of their best traits have been inherited from former generations, and little, if any, progress in the right direction has been made by the present. Indeed, it is doubtful whether, in view of the available means and opportunities of the people, the earliest houses on this continent were not better than the most recent ones. The men of our day have been drawn into the adoption of some improvements by the progress of invention and the arts, but in the exercise of a sound judgment, and in careful adaptation of their means to the ends desired, they cannot claim to be in advance of their grandfathers.

There are not many dwellings of the last century remaining without essential modifications. Occasionally, on some New England hill, far removed from the changes which railroads bring, a venerable farm-house may be found which tells a story of its builders well worth the reading. There is the kitchen, where:

> "Warm by the wide-mouthed fire-place, idly the farmer
> Sat in his elbow-chair, and watched how the flames and smoke struggled together."

That hearth was made to hold no compact cooking-stove, nor is the fire-place designed even to burn wood economically cut with a saw. Where wood is plentiful and labor scarce, the fire-place must be large. The room is capacious, for there the loom, and the spinning-wheel, and the broad settee had their places; there the family meals were taken; there all the household-work was done; and that was the family gathering place. At one end is the cheese-room, or buttery, in no danger of too great heat from proximity to the kitchen chimney; at the other was the "old folks" bed-room, in a position commanding all the approaches to the fortress; and near it the stair-case, by which the rest of the family ascended to the apartments where they shivered

*A "premium" row of twelve cottages was built, in 1848, in Berwickshire, all under one roof, each house having two small rooms, an entry, and a pantry, on the first floor, and a low loft, accessible by a ladder, above, the whole space inclosed being 25 feet by 17 feet. A permanent bedstead was built into a recess in the sitting room, which it entirely filled, somewhat like a ship's berth. There was a small out-building for each tenement, but not a porch, or shade, or shelter of any sort, outside the walls, though the windows were dressed with stone Gothic moldings. These cottages were specially praised for having brick floors, "a very great improvement upon the clay floors usually met with, and, also, that they were all raised a step above the exterior level."

The same meager accommodation is shown in dwellings of a higher class. In some farm establishments, furnished with steam engines, mills, feed boilers, and the most complete accommodations for the storage and preparation of provender, the housing of cattle, the sheltering of carts, and the protection of the manure heap, the farmer's own residence has but the two rooms and scullery below, and one, or at most two, low sleeping rooms in the garret.

through the winter nights. In front are two "square rooms," each with its fire-place connected with the great central chimney, one of which, devoted to tea-drinkings and other solemn occasions, was a sealed apartment on other days, while the other was used as a sleeping-room for guests, or an occasional sitting-room.

With some modifications, this, in its arrangement, was the type of most northern farm-houses. It was simple, certainly, neither requiring nor exhibiting much ingenuity in its design. The wants and habits of its builders were even rude, but it met them and did it well.

In outer form and construction the earliest houses were built with strict regard to the resources and necessities of the locality.

In New England, where timber was always abundant, and water-power everywhere available, saw-mills were early erected, and boards became the invariable material for covering the frames, formed of hewn timber, put together in all its huge dimensions, from sheer avoidance of the labor of reducing it. Men skillful in this mode of construction showed to less advantage when attempting to form the refractory granite into their clay-jointed chimneys, for lime was scarce and bricks were made only in widely-scattered localities.

On the banks of the Hudson, well supplied with clay and lime, and easily-broken stone, we find the walls of nearly all the old houses built of stone or brick, or both combined.

A similar construction prevailed on Long Island and Staten Island, the lime used being made from shells. Such parts of walls as were covered with wood were mostly shingled, there being little water-power for sawing boards on the islands. In each case there was the most judicious regard to the peculiar resources of the locality. As we come south, we find a change in the common arrangement. Heating the house in winter not being now the most essential consideration, the central chimney is dispensed with, and in its place an open, airy hall extends through the building. At each end of the house there is a chimney, sometimes built entirely outside the walls. Shelters become more common, too, the roof itself sometimes projecting over to exterior posts, forming long verandas.

The shape of the house was also adapted to its materials. The builders in stone for stability kept their walls low, and covered them with a broad roof, of moderate elevation, affording lighted rooms only in the gables, or obtained a second story by a double slope, (in what is sometimes called the "gambrel" form,) lighting it with dormer windows. The worker in wood could carry up his frame safely as high as he pleased, and thus two full stories. Frequently, in New England, this elevation only extended over the front rooms, the roof, having exalted itself for a little space, rapidly subsiding until it reached the rear, and modestly spread its shelter just over the kitchen door. Such houses certainly exhibited an ostentatious front, little consistent with the meagerness of their every-day appointments, and quite at variance with the stable, modest, hearty aspect of those which attained their highest position by a gradual and well-balanced rise upon a broad and firmly established basis. Whether in this respect any of them betrayed characteristics of their builders, we may not attempt to judge, as they have all passed away together. This is certain, that in all of them

the materials most suitable were selected, and used with judgment and thoughtfulness, to accomplish the end desired. There may have been an imperfect appreciation of the advantages to be sought in a home; and the mode of building may have been to a great degree the result of necessity, or to some extent influenced by recollections of the lands of their forefathers; but it was adapted as fully as possible to the purposes in view and to the means at hand.

While the general model was nearly the same, as the common wants were similar, there was all the variety called for by diversity of situation and circumstances. In this respect, the change to our times has been very great. With some noticeable exceptions, among all the numberless forms which are seen, there is little of that variety which is the proper result of peculiarities of location, circumstances, or personal character. With greater costliness, there is less care. With much less of uniformity, there is more of imitation. While each man seems to assert his freedom from antiquated customs, and his determination to build in his own way, as every American should, the greater number vindicate their privilege by adopting the way of some one else. The very abundance of our resources, and the freedom of our choice, instead of inciting to a wise discrimination, seem only to have developed an inconsiderate lawlessness.

We cannot in this connection trace the causes and manner of the change that has taken place, but it may be useful to consider some of the influences that have been, and still are, at work to prevent the improvement which we ought to see.

Chief among these has been a tendency to regard the mode of any novel procedure, rather than its reasons; leading to careless imitation of inappropriate patterns. As some thinking man has partially changed his mode of life, introducing new refinements, creating new wants, and modifying his house to meet them, his neighbors, compelled to acknowledge the improved aspect of his homestead, have copied the form of his house, but have not followed the new habits of living which occasioned its adoption. His family may have enjoyments and occupations not confined to the kitchen-hearth, and the house may cheerfully make the fact known by the more prominent and spacious front apartments. His imitators still make the kitchen their habitation, but it is smaller than their old one and less comfortable, and, with them, the rest of the structure is an ostentatious, superfluous, dreary waste.

Domestic habits must change among an active people. Threshing machines and reapers have revolutionized the out-door work of farming. The sewing machine has supplanted the spinning-wheel; newspapers, district libraries, and cheap burning fluids, have afforded opportunities for more rational occupation than smoking long pipes, or shelling corn on a shovel.

It would be folly not to meet these changes by corresponding modifications of the domicil, and it is no less so to adapt our houses to the habits of other people, in disregard of our own. All the fashions in building which, like waves, have successively swept over the country, have been productive of erroneous notions and false tastes, except so far as they have coincided with real changes in the mode of life, or improvements in material construction.

The departure of farm-houses from the simplicity of their true purpose is, in great part, owing to the attempt to make them "architectural." The rambling, capacious, and home-like residence, built with no object beyond the convenient, economical, and comfortable accommodation of the household, has often given place to some formal and pretentious structure, contributing little to either comfort or convenience, erected in fancied conformity to some ideal model of architectural correctness, with columns and pediments, capitals and architraves, frieze and cornice, all according to the books, as though it were one of a uniform lot, made by machinery, like Yankee clocks, and sold to make room for a new stock of different pattern. As extremes in fashion follow one another, the neighbor who builds next afterwards has, perhaps, a "Gothic" model:

> "All up and down, and here and there,
> With Lord-knows-what of round and square,
> Stuck on at random everywhere;
> Indeed, a house to make one stare,
> All corners and all gables."

Even the veterans are not left to wear out their days in peace, content in the enjoyment of their own homeliness, but the hand of "improvement" is laid upon them; they are stripped of their little acquisitions of stoops and sheds, and similar matters, which for pure convenience they have gathered round them, cramped and tortured into reluctant regularity, tricked out with vergeboards like ruffles, and then passed off as samples of a reformation effected by correct rules of art.

It is not strange that the independent, thinking man, accustomed to judge of everything by a reasonable consideration of its design and its results, should say: "Architecture may be very good in churches and court-houses, but it is out of place on a farm. We want houses to live in, and cannot afford to sacrifice our pantries, or bed-rooms, or the chief value of our more important apartments, for the sake of regular arrangement of windows, or an exact proportion of width, length, and height of the whole building. I have my own notions about my house, which I intend to carry out."

He does carry them out, but when he has occupied his new house awhile, he finds that new notions have been acquired by experience, which it would have been well if he possessed earlier. His doors, perhaps, are just where they ought not to be, or his stairs are not pleasant to climb, or in some other of the thousand things which experience would have taught him to provide against his house is not so desirable as it might have been.

Now, both of these classes err from a mistaken idea of the real meaning of architecture. It is supposed to be an inflexible set of rules, made by some infallible authority, invariable in their operation, and to be applied alike to all buildings, great or small, allowing a certain degree of liberty in the selection of the special order or style to be used, but beyond that giving no scope to ingenuity or originality. If the building is not one to which the rules seem applicable, that is considered the fault of the building, and the remedy is not in changing the architecture, but in using less of it. To builders of this way of

thinking, the classic orders are as well defined, and their limits as accurately marked, as the separate States on a map; and they will tell you the exact outline which must be adhered to in any Gothic arch or molding as readily as describe a circle with the compass.

Now, all this is not science, but conceited ignorance. No two Grecian buildings have been found to be alike. No one of those which have been measured and delineated agrees with what are considered the established proportions of Grecian architecture. Each separate edifice was designed for its own specific purpose, and with reference to its peculiar location and circumstances. So far as those purposes and circumstances coincide with ours, the buildings are as suitable for us as for their original possessors, and no further.

In the best Gothic, of all its many styles and periods, there is still greater variety. Not only do the buildings possess each its own character, but in the same structure the minor details show the peculiarities of the different artificers, so that, in some instances, scores of capitals in the same ranges of columns, all harmonizing in general form, show each a new design in the detail of decoration.

Says Ruskin:* "It is one of the chief virtues of the Gothic builders that they never suffered ideas of outside symmetries and consistencies to interfere with the real use and value of what they did. If they wanted a window, they opened one; a room they added one; a buttress they built one; utterly regardless of any established conventionalities of external appearance, knowing (as indeed it always happened) that such daring interruptions of the formal plan would rather give additional interest to its symmetry than injure it."

The original architecture of Egypt, Greece, Rome, Venice, and Northern Europe, differ widely from each other in regard to forms, materials, scientific construction, perfection of finish, and harmony and grandeur of effect. But they are all true to the one principle of faithfully employing all the means and skill possible for the very purposes which, in each single instance, were to be accomplished. This variety and adaptation, so far from being inconsistent with noble architecture, is its very life.

Correct architecture is not inconsistent with true economy. It demands it, as essential to all good building, although it condemns any penny-wise parsimony, which would withhold those things needed to give the house its greatest value, as well as the spreading of a limited amount of means over a great space for show, instead of concentrating it for utility. Nor is architecture proud, even in its noblest works, it modestly keeps itself subordinate to the great purpose, and without condescention it takes equal delight in the humblest dwelling.

What is it? The experience of others gathered for our use—thought. The construction of *our* buildings so as best to suit *us*, with the very best use of the means at hand. It is, in fact, doing what we have to do in building just as judicious men do any other important business; first determining exactly what we need, and the means and obstacles to its accomplishment, and then devising the best way to make our means accomplish our desires.

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*Stones of Venice, vol. 2, p. 179.

One great cause of poor building is the careless way in which it is undertaken. Long preparation is made for the materials, in some cases, and plans are early laid for meeting its cost, but to the purpose and character of the house itself no adequate care is given. Thought, the material more valuable than all others which enter into the structure, is scantily bestowed. How few enter into any deliberate study of their own mode of domestic life; what it is from month to month; what are its chief enjoyments; and what its inconveniences and annoyances, and the causes whence they arise; how it is affected by the form and peculiarities of their dwelling, and how its pleasures might be enhanced, or its labors and discomforts lessened, by a modification of the habitation! A still smaller number ever investigate their habits of thinking, the origin of their opinions and prejudices, or trace the influence of material objects, and especially of the scenes of home, in the formation of the characters of children. Yet, without having given this thought to it, no man can intelligently determine the first point of size, form, or appearance of his proposed dwelling.

The farmer says: "I can spend so many hundred dollars. I guess that will build me as good a house as Mr. Smith's." So he goes to a carpenter and bargains for his home as he would for a cart or a plow, though often with less deliberation. If anything like a plan is drawn it must be done at once, so that the work can be begun without delay; and crude and ill-digested, with little examination, and seldom any real test of its merits, it is adopted, and the household put to constant inconvenience for their whole lives, in order to hasten by a few days the erection of the domicil. The importance of thoroughly studied plans, before beginning to build, cannot be too strongly urged. Economy not only demands that the intended building should be so fully delineated in all its parts before its commencement, as to prevent mistakes, misunderstandings, or omissions, in its execution; but it also requires every part to be so carefully designed that, by no oversight or parsimony, shall there be an unnecessary debt of life-long labor imposed on its occupants. Such things as apartments separated which ought to be close together, or doors and pantries badly located, daily causing many needless steps to the housekeeper, year after year, in effect levy a perpetual tax upon the occupants for the heedlessness of the designer. If it is the time of servants which is thus consumed, the tax is paid in money; if of his own family, it is not less burdensome. But the case is worse when the health is endangered, or cheerfulness and home comfort driven off, by such thoughtlessness.

The first step in fixing upon a design, the determination of one's own wants, is the most difficult of all; the one requiring most time; the one adding most value to the house, and yet the one most neglected. Before a man can intelligently decide what kind of house he will build, he must know what he needs, why he needs it, and what of his necessities are most imperative; for planning of houses is but a choice of sacrifices. No one ever yet comprised all the advantages which were desired, some of which must, in any case, be given up. The owner ought always to have determined in what order they shall be yielded, before any idea of exterior size or form shall have been entertained by him. This is requisite also in order that we may rigidly exclude from

our plan everything that does not meet some useful purpose of our own, for whatever is superfluous is both wasteful and positively detrimental.

"But," says one, "that is too strict a rule. It would cut off everything that makes houses pleasant, or gives them beauty, and leave them bare, unsightly boxes." Not so, unless you take a very narrow view of the purposes consistent with the most perfect domestic enjoyment. Not unless all is superfluity and luxury beyond sustaining an animal subsistence and saving money. If, on the other hand, the enjoyment of thought and feeling, the cultivation and refinements of the intellect and tastes, are consistent with daily duty, then the house may with propriety be made to contribute its aid to those ends.

It is for each man about to build to determine for himself what purposes it is most desirable to accomplish. A few, however, of those common to all country residences may be profitably examined in detail.

All efforts to make a pleasant dwelling will be, in a great measure, thrown away unless its position is chosen wisely, and even then care must be taken to overcome whatever may be its natural defects, and to make all its advantages available.

It must, first, have a wholesome air. Observation shows that there are few large tracts of ground in any part of the country without unhealthy portions, and that the distance between a location where the residents shall enjoy perfect health and one quite the reverse is often very small. It may not be practicable to determine the reason of this, nor the probability of the existence of miasma at any special point, without the learning and skill of a medical man. If so, his counsel should certainly be had, for it is not prudent to fix upon a site until its perfect healthfulness is made sure.

To secure a good atmosphere, even where are no miasmatic influences, there must be ground near the house lower than that on which it stands, where the heavy vapors may gather by their own gravitation. Every one has seen the fogs filling a valley like a lake in an autumn night, completely enveloping the dwellings, and gradually ascending till they are dissipated by the rising sun, while the residents upon the hill-sides enjoy their customary dry and invigorating air. The same process goes on at all seasons, though the heavy and noxious vapors are only visible at certain times.

A site on rising ground is also desirable to secure dryness around the house. There may possibly be farms on which there is no spot that can be made dry and hard at all times, but it is difficult to believe that such a farm can be fit to live on. If there are any virtues in underdrainage, it certainly will pay to appropriate them in the fullest manner rather than suffer the inconvenience of mud, and ice, and filth constantly lying in the path. There are houses where the labor imposed on the housekeeper by muddy paths, in a single season, is more than would suffice to make them thoroughly and permanently dry.

The site for the homestead should be so chosen as to facilitate, as much as possible, the labors of the farm. Some houses seem to be located for the convenience of pedlars, so near the public highway as to receive the dust thrown up by every passing vehicle. As the farm-

house and the other buildings adjacent are the center of the farm operations, it would seem more reasonable to locate them with reference to the work to be done and their daily use, rather than their occasional access from abroad. A house standing a moderate distance from the public road certainly wears the appearance of independence and home-likeness, and indicates a family living comfortably by themselves, beyond public intrusion.

Nor should the builder overlook any advantages of prospect, or beauty of situation, which may be available, either to make his house pleasant to its occupants, or more agreeable to observers. There are many old residences, and not a few new ones, located in some low and unpleasant spot, where there is little to cheer the eye from within, and less to render the place attractive from without, for some half-considered and mistaken notion of money-saving, when near by a site offers the advantages of beauty which the other lacks. And generally it will be found that the most agreeable site will be the most economical one.

There is one consideration, in connection with the matter of prospect and appearance, that seems often to be neglected. If a railroad happens to pass in sight, its trains, as they flash by, showing nothing but the same black engine and yellow box-like cars, day after day, people seem to think that because they see no passengers there are none to see them, and so put the unsightly side of their houses toward the the track, to be seen by hundreds, and the best front toward the highway, traveled by a few scattering neighbors.

One of the first and most important things to be regarded in the selection of a situation, is the supply of water for the family use. To those who have enjoyed such advantages, it is unnecessary to suggest the increased value given to any plot by a living spring of pure water, in such a location that it may be readily conveyed into the house, or be driven there by the tireless energy of a hydraulic ram. Men, who have never known this comfort, often look with astonishment upon what they consider the extravagant expenditures made by their neighbors to accomplish this object; but a proper estimate of the labor wasted in carrying water from a distant spring in pails, or drawing it from wells with a clumsy sweep, and the losses resulting from the want of it in abundance, would show that their own course is less thrifty. If, however, there is no source from which a supply can be drawn, except by manual labor, there is no way so cheap as pumping; and the man who cannot have running water, is inexcusable if there is not a serviceable and easy iron pump by the side of his kitchen sink, unless the fountain on which he must depend is too distant or too low for the successful operation of a pump. The case is then, indeed, unfortunate; but, after all, not so bad as many contrive to make it.

If a well must be resorted to, it is worth some pains to make it a pleasant, safe, and comparatively easy source of water supply, nor is it a difficult task to accomplish. A well-house may be constructed so as not to be very burdensome in cost, though greatly superior to the arrangement of most wells. Let it be large enough to afford a protected space on the floor for the drawer. Let it have a safe curb, and a spout opening into a tray, where the pail may be placed, so arranged that any superfluous water shall be conducted off without covering a

considerable area around with mud in summer, or ice in winter. For raising the water, the best arrangement is a counterweighted windlass overhead, or a swivel-pulley, and two buckets. If not too far removed from the house, this seems to reduce the inconvenience of an open well to the smallest degree, and may be made a pleasing and ornamental feature of a homestead.

The use of rain water for all the purposes of a family is becoming more common throughout the country. It has the advantages of freedom from earthy impurities, and a supply irrespective of location. The roof on which it is collected must be of such material as not to injure the water. The cistern should be large enough to hold a store for times of drought, and the water should be filtered as it enters the cistern, and after it is drawn from it, though the latter filtering is often dispensed with.* Of course, with a rain-water cistern, it would be folly not to have a cast-iron kitchen pump.

The supply of water involves the necessity of drainage. There are hundreds of farm-houses whose back doors are passed in winter only at the risk of falls and bruises. The latest ice which departs in the spring is the solid mass formed by the accumulated waste of a whole season, poured from the threshold. In summer, instead of being fragrant with flowers, the place is redolent of evaporating soapsuds.

Now, if no other disposition can be made of this waste water than to let it soak into the earth, it is better that it should do so elsewhere than just under the kitchen windows, or before the entrance door. An underground drain can be formed to a cess-pool without any great cost or labor, if it cannot find an outlet where its contents shall enrich a hill-side. Into this drain should lead a pipe from the kitchen sink, and in some convenient place there should be an opening for emptying wash-tubs, &c., both protected by stench-traps, which are only such bends in a pipe that water sufficient to fill it shall be retained for a little space, preventing the passage of foul air.

Provision is also to be made for carrying off the rain water which falls on or around the house, so that it shall neither form gullies nor stand in pools. Except in rare cases, eave-gutters seem indispensable, even where the rain water is not conveyed to a cistern.

In many locations, the natural moisture of the soil is such that, unless otherwise drawn off, it will descend into the cellar, which, in that case, must itself be drained by some means to render it valuable. So obvious a fact it would be almost ridiculous to mention, if there were not so many cellars unnecessarily flooded year after year.

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*The filtering cistern may be made with a partition wall, (*a*,) pierced at the bottom with several apertures. A wall, (*b*,) on each side of the partition affords a space to be filled with pure, broken charcoal, alternating with clean gravel. The water first enters one compartment of the cistern, and is pumped out of the other. A level is, of course, maintained on both sides, without a violent current through the filter, or danger of overflow in heavy showers. But it is difficult to change the charcoal, or to restore it, if displaced, except when the water is low. A plan, better on some accounts, is to have the rain enter the cistern through a cask or box, sunk in the ground, having a pipe from its bottom, the orifice of which is covered by wire gauze, or a course sponge, with charcoal kept in place by gravel over it.

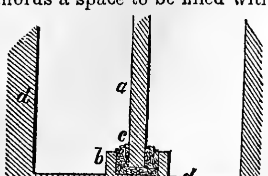

Fig. 1.

Another thing for which provision is to be made in every house is, a sure and constant supply of pure air throughout the building. The want of this is most obvious in cellars, where are naturally collected the heavy gases and vapors from the house, to which are added many noxious emanations from decaying vegetable matter, giving the air a peculiar cellar-like odor. But, though the air of the cellar is commonly dense and heavy, there may be light gases generated there, which, ascending through the house, may produce sickness, the cause of which shall not be understood. It is, therefore, important that every such place should be often cleansed, and that there should be means of thoroughly and frequently changing its atmosphere.

Whenever water is seen to stand on walls or windows, either as dampness or frost, it surely indicates a moist condition of the air of the room. With perfect ventilation, this evidence of vapors should never appear. It may not be practicable to attain to entire success, but, so far as possible, the air of every room should, by steady changes, be kept as pure as that outside the walls.

The steams of the kitchen and wash-room should be at once conducted off, and never allowed to penetrate any other portion of the house.

Especially is pure air needed in sleeping rooms. It is important for the farmer that this should be attended to in *all* the dormitories of his establishment, in such a way that the supply shall not depend on the judgment of the occupants. If he doubts this, let him spend a summer night at some road-side tavern, and when he wakes in the morning, dull and languid from sleeping in a close, hot room, let him say whether it *pays* to lodge the laborers who are to do his work in such places.

It is important, both for the maintenance of pure air and the preservation of the timbers from rot, that there should be a considerable space between the floor and the earth, under the whole extent of a house. Such portion of this area as is requisite will be used for a cellar, and the rest, in cold climates, should be so arranged that it may be entirely inclosed, or opened at places for a circulation of air at pleasure. In the Southern States it is found advantageous to have this space left as open as possible, by supporting the house on scattered piers, allowing

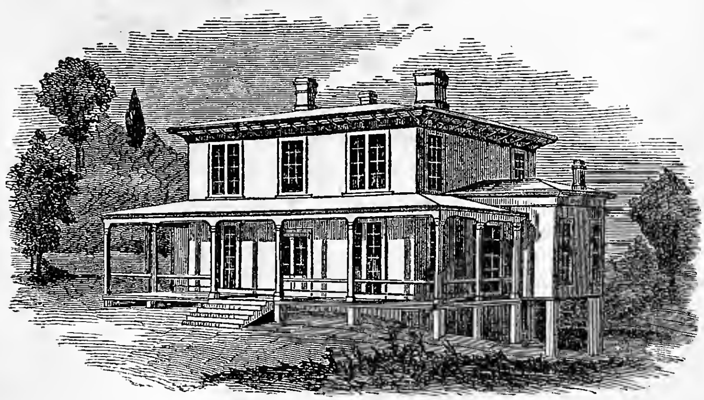

Fig. 2.

a constant draft below the floors. This tends both to cool the house and to carry off any offensive exhalations from the ground underneath.

An indispensable requisite of every good dwelling is protection against external heat and cold. The walls, floors, and roof, must be so tight as to exclude the winds and cut off all unwelcome drafts of chilly air. They must, also, be so constructed as to retain the heat within in winter, and to exclude it in summer. The chimneys and fireplaces are to be constructed so as to burn economically such kinds of fuel as the circumstances of the locality render most expedient. Their position and number should be such as to accommodate all the rooms where fires are wanted.

Too little light is admitted to our dwellings. Even in those which are brightest, the doctors say there is not enough of direct sunshine. To prevent the fading of carpets, or for other reasons, low and small windows, green blinds, and one or more thicknesses of curtain, are all made use of to render our rooms as dim and dismal as possible.

We pity the palid and sickly children of poverty in cities, crowded into overflowing tenement houses, which tower high beside narrow alleys, where sunshine never penetrates, or sympathize with the prisoners sighing in dark dungeons. Why is the darkness worse to them than to those delicate young ladies who are always thickly veiled when they go out of doors by day, and from whose rooms the bright sunlight is at all times studiously excluded? Their chalky countenances and imperfect eyesight attest the results of the practice. It is said by good authority that the superior healthfulness of the English women, and the retention of their beauty to a period of life much later than that at which nearly all American ladies fade, is owing not less to their exposure to sunlight than to their enjoyment of the open air. Light was the first day's work of creation. It is a sin—a sin against light—to shun it and exclude it. Let us have large windows, and enough of them.

But, though we want light and sunshine, it is not necessary that we should endure the latter, with its accompanying heat, at all times of the day or year, and on every side of our dwellings. In those directions exposed to the sun's rays in the hottest part of the day there should be some protection. A verandah shading the walls will do much toward moderating the heat within the house. It also shelters the windows from storms, permitting them to remain open through summer showers, and affords a cool and pleasant place for sitting in the evening, unexposed to the unwholesome influences of the falling dew. Verandas have always been characteristic features of southern houses. In more northern regions they are to be used more sparingly; but in the right place, and to a proper extent, they are there none the less useful or desirable.

It is always desirable to have the interior division and arrangement such that each apartment shall be well fitted for its appropriate uses, and that all shall be so connected and placed as to bring together those between which passage is most frequent. It ought to be practicable to pass from any one room to any other without going through a third, and without waste of room in passageways. What halls are needed, if made spacious, contribute much, in warm weather, to the coolness and pleasantness of a dwelling, by affording through currents of air.

They should, however, be made so that these currents may be cut off when desired. If too large, they add to the labor of a family, and increase the trouble of warming the house.

Contrary to a too common practice, the kitchen is to be considered the most important apartment of a farm house, as on the perfection of its arrangements depends much of the comfort of a family. It ought to be large enough for the easy performance of all the work that is to be done there, without unnecessary magnitude. All its accessories should be arranged around it in the most convenient manner, and the whole must be adapted to the pursuits, the habits, and the peculiar notions of the housewife. If she personally superintends her own work, or does a large share of it with her own hands, as most farmers and mechanics' wives do, there should be a ready communication with the ordinary sitting-room, or the one where her time is mostly spent, that neither time nor steps may be wasted when she is suddenly called from one room to another by her multifarious labors. The place where crockery is washed should be near the closet where it is kept, and not far from the entrance to the eating-room where it is used. The pantry where provisions are stored ought to be close to the table where they are prepared for cooking, but so far as possible cut off from the kitchen steams, and provided with its own means of ventilation. The secret of the ease with which some women accomplish so much more than their neighbors may, in part, be found in such little plans for economizing labor as these.

If servants are depended upon for the work, it becomes necessary to provide a storeroom, where provisions may be kept under lock. It is better to have an entrance other than from the kitchen, with, perhaps, a small window for the serving out of stores. It should be lighted and ventilated, and capacious enough for convenient arrangement of provisions, and, generally, is best located in the coolest corner of the house. In such a household, too, it is better to separate the kitchen from any other apartment by at least two doors.

The supply and kind of fuel will control the form of the kitchen fire-place. Appliances for baking and boiling, with a constant supply of hot water, are, of course, essential in any event. Whether to these are to be added conveniences for roasting meats, and other operations by an open fire, for boiling clothes, heating irons, &c., is a matter to be determined before building. If the family washing is to be done in the kitchen, as is often the case, not only the fire-place, but the whole kitchen should be contrived with reference to it, so that the tubs, the ironing-table, and the drying-horse, shall interfere as little as possible with the every-day operations there carried on. But it is always better, if practicable, even in the smallest dwellings, and frequently is more economical in the first instance, to have a distinct room for washing, having its own fire-place, with boiler set in brick-work, and its own drain. This will be found very convenient for many other than laundry affairs, which otherwise would interfere sadly with the

daily routine of the kitchen.* Such a room need be neither large nor expensively furnished.

On a dairy farm, unless so extensive as to justify an entirely distinct establishment, there will be much additional work to be done in the kitchen, affecting the dimensions proper to be adopted, and the arrangement of its appendages. The store-room will need to be larger, or there must be another room specially devoted to the dairy, in a cool position, and capable of being at the same time darkened and ventilated.

A cellar is needed for the storage of many articles which must have a cool or moist air for their preservation. Though the construction of the cellar is seldom the subject of much care, and its qualities are looked upon as matters of luck, there are some things worth attending to, which will materially affect its value. Its ventilation and drainage have been already mentioned. In the cellar is oftenest felt the need of a protection, which should extend throughout the building, against the inroads of rats and mice. The division and fitting up of this part of a house should be, with reference to convenience of getting in provisions, without needless or dangerous obstruction to those who shall have occasion to explore its dark recesses. The inside stairs should be from the kitchen, or contiguous to it; and, for facility of frequent cleansing, there must also be an entrance on the outside, or from a wood-room.

There are men who, year after year, leave their fuel scattered around the house, to be wet with every rain, and only to be cut up as wanted for daily use. As such persons will not be likely to read suggestions for improving their mode of life, there is no occasion here to urge the importance of wood-houses; but the hint may be in place that the wood-house should have a covered connection with the kitchen, and that under its roof may be located the tool closet, outer cellar, stair-way, and other conveniences, to the increase of both the comfort and health of the family.

The eating-room may be considered a place where the necessary amount of food may be swallowed with the least loss of time; and, in

* Figure 3 is the plan of a kitchen-wing of moderate accommodations. The kitchen itself is perfectly symmetrical, and connects on one side with a closet, hall, cellarway, and one of the front rooms. On the other side are a dish pantry, with sink, a store pantry beyond, and a wash-room behind the side entry and back staircase, with oven and clothes-boiler. In this case the kitchen is relieved of much of its most troublesome work, and would be a very pleasant room.

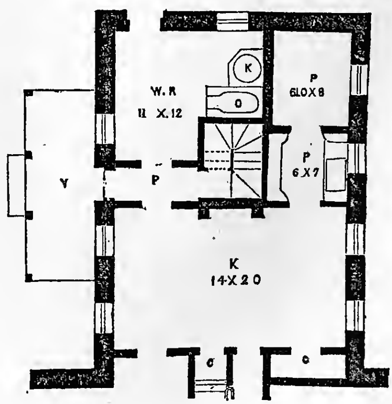

Fig. 3.

this case, the table is very likely to be set, not in a distinct room, but as near where the food is cooked as possible; or, it may be recognized as the gathering place of the family where, at regular seasons, all the members come together to enjoy, not alone the pleasures of appetite, but the higher and more lasting ones of social intercourse. From the custom of the family in this respect may be judged much of their character. If the anticipations of mealtime are connected with any other enjoyment than such as the cattle may have, in common with their keepers, it is desirable to make the room as pleasant as practicable, to escape the effluvia of the kitchen, as well as to avoid the necessity of hurrying the repast to make room for kitchen-work.

The dwelling is to furnish proper apartments for lodging all the members of the household, and such provision for the accommodation of occasional guests as may be expedient. The amount of space devoted to sleeping-rooms must be regulated much by the means of the builder. There is a wide range, in this respect, from the house where each individual occupies a separate apartment to the one in which there are beds in all the rooms. It needs no argument to show the undesirableness of using, at night, rooms devoted to the common household purposes during the day. All bed rooms, whether occupied by one or more persons, should be easily and safely accessible, airy, well lighted, and so finished as to be protected from external heat and cold.

To none more than to those engaged in agricultural occupations is the frequent use of the bath essential, on the score both of health and comfort. The room required is so small, and the expense may be so light, that a bath room in a farm-house seems hardly to be a matter of choice. Of course, the extravagant conveniences of city mansions, with the luxury of cedar and marble, carpets, and hot air, with hot and cold water running at the touch, from silvered pipes, are not to be had without proportionate cost, as well as great trouble in the arrangement of the house, and some danger from leaks. But a plain bath-tub, to be filled, and perhaps emptied, by hand, in a small room on the ground floor of the house, or one of its appendages, is within the means of a house builder. If once put in, and fairly tried, it will not be removed by advice of the family physician.

The first demand which ladies make, when they begin to talk about a new residence, is for closets. They want pantries for their kitchen implements and stores, of course. There must be large clothes-presses, in connection with the sleeping rooms, especially those of the feminine part of the household, for their wardrobe is expansive in these times. Then, there are the blankets and quilts to be stowed in the summer, besides a thousand things which have to be kept, but are seldom, or never used, altogether making a great deal of room for such purposes that must be found somewhere. This looks like a little matter, but, as usual, the ladies are right. There are few things that add more to the comfort of a residence than proper conveniences of this kind, and the skill of the designer is exhibited in the economical provision for this want as often as in the magnificence of the parlor, or the symmetry of the exterior.

So far, we have considered only such things as pertain to physical comfort. All these features would be desired though the house were not to be occupied by a single individual who had an idea or an aspiration beyond

his mere bodily enjoyment, or knew that life had any duties or pleasures higher than eating, sleeping, and avoiding pain, and overmuch labor. But there are duties as well as enjoyments of a higher nature than these clustering around a family home. Here is the center of all the best associations of life. Here the education of the rising family is to be mainly conducted, and the foundation laid of the character which, for good or ill, is to continue through life. It is important that obstacles to its best development should be removed, and whatever of assistance in this work may be derived from the objects of daily familiarity should be secured.

In this respect, the dwelling has a double function to perform—contributing to the enjoyment, and aiding in the education of its inmates.

In all things it should be made as attractive and cheerful as possible. Whatever promotes convenience, also tends in this direction, but much may be secured by attention to the apparently minor details of arrangement.

Every point and portion of the structure should be consistent with truthfulness. The art which obscures unpleasant features, or makes prominent those more agreeable, which copies a natural form for its beauty, or paints a surface a hue pleasing to the eye, which would otherwise be harsh and objectionable, is never out of place. But the deceitful artifice which represents any object to be that which it is not, or which in any way violates the most downright sincerity, ought to be offensive to the adult, and is always dangerous to the young. It is consistent neither with good taste nor good morals—never in opposition to each other.

The various labors and occupations carried on by the members of the household should have apartments and accommodations suitable to each, and so contrived that they may not interfere with one another. The sewing of the family can be done in the kitchen, but it certainly is not the best arrangement, if a light and pleasant room can be used elsewhere without the necessity of entirely removing work every time it is laid down for a moment. Such a room, if used as a family sitting room, should have whatever advantages of pleasant prospect the site may afford. It should be a quiet place, undisturbed by any of the more active avocations of the family. In many families there is but one such room, and in it those who read and those who work, and the younger ones who try to study, as well as those who play, all are grouped together, some disturbed and confused by the noise around them, or the rest silent, solemn, and stupid. There is no cheerfulness in this.

There was a low, brown house, on a bleak and rocky hill, just at the outer edge of a Massachusetts school district. Its front entrance was perpetually closed, but at one end the door opened directly into the large, low, dingy kitchen, dimly lighted by a single small window, opposite to which, stretching its huge dimensions along the side, was the yawning fireplace, roughly built of stone, with a blazing fire of green wood in one end. Between the two stood the tea table, spread with all imaginable and unimaginable farm dainties, awaiting the arrival of the schoolmaster at his temporary home, in his routine of "boarding round."

When the table had been removed, a stand was brought for his special service, from the best room, to hold the sputtering, dripping,

dipped tallow candle, by whose feeble light he painfully perused his book. The two lads, his pupils, not allowed to profit by the unusual extravagance of two candles, were left to seek their illumination from the blaze of the hickory on the hearth or the candle on the high shelf above. By the same light the father whittled out rake-teeth, and the mother patiently worked at the week's mending, only occasionally stopping to try to still the cries of some of the younger children, who rolled and tumbled promiscuously over the hearth, and in and out of the capacious fireplace.

Is it any wonder that those boys dreaded the approach of evening; that they preferred the sunny side of the barn to the house, and the companionship of their favorite cattle and colts to that found around the family hearth; or that they ranked at school among the dull scholars; or that they learned no lessons at home?

They did learn lessons at home, however, which a long lifetime would not efface nor wholly counteract, but they were not such as were read in their books by those who taught them.

It would not be so easy to draw the companion picture from the life. May we not hope that fit subjects will be more frequently found in the future than in the past?

A mature and disciplined mind can be fixed upon a study, regardless of the confusion around; but it is not so with children. If they are to learn lessons at home, they should have facilities for doing so without confusion. Generally, too, there ought to be a place where reading or study may be pursued by the older members of a family, without being disturbed or imposing a restraint upon the conversation or even the hilarity of those not so engaged. The room need not be large. It might serve, generally, as the office, where the farmer should keep his account books, his maps or plans, his agricultural books and newspapers, and transact business with his neighbors. Would not such a room be remembered pleasantly in later years?

A most important object is the durability of the structure—a permanence, if possible, that may allow children's children to visit their ancestral home—at any rate, a construction so substantial that the expense and inconvenience of great or frequent repairs may be unnecessary, and the evils of early dilapidation avoided. Security from fire is also to be thought of, and effected to the greatest practicable extent.

Thought should also be given to future enlargement, that, as habits change or condition improves, there may be room to grow, without bursting and discarding the shell which is found too contracted.

It is not well to build without thought for the times when sickness will claim a room for its accommodation, nor to overlook the possible demands of social parties, occasional meetings, or even more solemn occasions, which may gather a concourse within the walls.

The house may contribute much to that satisfaction which results from the love of order. The value of closets, in affording "a place for everything," has been alluded to. As this is different from "tucking away" things, to put them out of sight, it is important that the closets should be lighted and well fitted with shelves and hooks, even if not large.

But this is not all. The appreciation and enjoyment of regularity, in form or arrangement, is one of the first of the faculties of taste

which exhibits itself. It is developed in different degrees, some persons seeming never to possess it all, and a still greater number never getting beyond it, or realizing that it is not the rule or measure of nature or art. A person of the former class, reared in a house in whose planning regularity was not thought of, its rooms all askew, and its exterior one inextricable jumble, may not be disturbed by its disorder; but one with a sensitive disposition, though he may not understand the cause, will suffer irritation every time his eye falls upon an object of which the portions on either side of its center are unlike. This feeling should be respected, both in consideration of the comfort of those whose habits are fixed, and the unconscious education of the young. It has its modifications and limitations, as we shall perhaps see, by and by. There is a symmetry higher than mere regularity, such as is seen in a magnificent elm, true in outline, but with no apparent correspondence or similarity of form in its branches.

It is the most perfect symmetry, combined also with variety, and this, too, it is desirable to accomplish in the house. There are houses with rooms all alike, in size, form, and relative position, and on a paper plan they appear very regular and pretty; but as no two of the rooms are to be seen at once, the advantage of their uniformity is imaginary rather than real. The same hint applies to the exterior. In all these things variety is to be welcomed, when introduced by convenience, and is to be sought for its own sake. Even birds' nests are not all alike, but vary with materials and situation.

Another feeling, which all experience, to some extent, but some more keenly than others, is an appreciation of gracefulness; the easy manner by which some persons can do what they please, in the first trial, in just the right way, without a superfluous motion or a hesitating one. In buildings, this feeling is gratified by those means by which the eye is pleasantly led along from one part to another, unoffended by harsh contrasts, abrupt changes of form, or obtrusive features. This feeling, too, is to be gratified, so far as practicable, but not at the expense of decision—the expression of purpose, which may be played with, but must not be obstructed.

And this is, after all, the chief thing to be kept in view, that, throughout the house, in all its proportions, arrangements, and minutest detail, everything shall be done for a well-considered, appropriate, and consistent purpose. Whatever is more than this is superfluous and injurious. The house being made for the purposes which have been named, and others of like nature, the whole external appearance should express them, unmistakably.

It may be difficult to make grown men comprehend what is meant by the *expression* of a house, but children understand it. How common is it to hear them, when traveling, characterize the residences they pass as "staring," "lonely," "wide-faced," &c., or to compare them to some person peculiar in feature or costume. It is certain, that some of the greatest faults of modern houses arise from attempts to make them express what is not true, by false representation of their component material, or fictitious indications of the habits and avocations of the inhabitants. The perfection of house-building may be considered a dwelling that meets the necessities of your disposition and mode of life, and proclaims to all persons what that disposition and mode of

life are; that, being a cherished and cherishing home, it shall appear so to all who see it.

But, says some lady: "In *our* house we wish to consult beauty, and your rules would restrict us to simple utility."

Perhaps it is best not to talk about beauty, until we understand what we each mean by the word. But if everything about the house is satisfactory to your own settled and well-defined feelings, is not that beauty enough? If it is not satisfactory, and you can point out a good reason why, then you have shown a *purpose* that it is proper to serve and to express.

Says another: "You have made no provision for any ornament or decoration. You would make our houses bleaker than our barns." Look again: If ornament contributes to gracefulness, or decision, or the expression of any other purpose or feeling consistent with your disposition and the real uses of the house, it is not only allowable but desirable. If, without any design, it is to be put on, it had better be left off. It is worse than savage finery. If in any design there is anything that can be taken away without being missed, either for its own effect of its influence on some other member, it does not belong there, is in the way, and should be removed.

"But what if I am one of that kind that cannot walk between hedges, but must make occasional leaps, just to show my vivacity and impatience of restraint?" Certainly, vivacity and exuberance of fancy are things very proper to show in their proper places, and nothing *serves its purpose* better than the expression of such things in the decoration of a dwelling. But your caprices must appear as such, and not be monotonously strung around a whole house. A really witty man does not copy jokes laboriously out of old almanacs.

"If we adopt this principle of using no feature of utility or decoration but for the execution or expression of a recognized and well defined purpose, what becomes of all that has been taught about congruity of styles? Shall we let all the past experience of the world go unused?" By no means. In house building as in making your farm machinery, it is your business to determine what you want. The mode of supplying the wants is a matter of skill. If you attempt it yourself, you must study and practice long and patiently, or your work will be very improperly done. When it is done, it will be found that others have already had to give (in part) the same expression, and to produce the same effects. The details invented by them are suitable for you, so far as the purpose for which they were invented coincides with yours. As the original purposes of each recognized style of building are commonly consistent throughout, and at variance with the purposes of other styles, so these details are generally harmonious when used together, and incongruous when mixed. It does not follow that if we adopt one feature of a style, we must copy it entire. To select and adapt judiciously to our own ends the work of those who have gone before us, is to use it nobly; to follow it servilely, without adaptation, degrades it and disgraces us.

We need not understand why these consistencies and incongruities exist between various forms, or how they operate on the mind; but before we attempt to separate or combine details, we ought to know

that they do exist, and what they are, and most carefully to regard them in all our designs.

But here comes one who complains that he does not like the idea that his house must show how he lives, and what his business is, and asks, "Why cannot I properly live in just such a house as my neighbor, the lawyer?" You can, if you live in the same way; but if, while you are plowing in the field he is dining with his guests, and while he is studying his cases you are asleep, what propriety is there in your building a great dining-room, or a library never to be used? If your kitchen is to be used for butter-making, and cheese-making, and feeding a half score of farm hands, is it not better to make it large enough for those purposes than a little thing like his, where only the cooking is to be done? If, however, you are unwilling the world should see these differences; if you are ashamed of your occupation, or, in other words, ashamed of yourself, may not I, too, be ashamed of you?

There is one more quality to be mentioned, which is, in most cases, the first and most constantly thought of, and that is, economy. But the economy of construction too often obscures the economy of occupation, really the more important of the two, though neither need cause the sacrifice of the other. Indeed, some men seem to build, not so much to make a house, as to avoid the expenditure of money.

It is sometimes thought that nothing can be consistent with economy that does not, in some way, tend to the increase of wealth. This is not true, if the judicious use and expenditure of money is as important as its accumulation. The cooking of meat does not increase a man's income, but no one would, therefore, consider its cost wasted. Neither is the money spent in what is sometimes called the ornament of a house wasted, if it promotes the objects for which a man lives, and for which his money is valuable to him. The question is, what, in each man's case, are the purposes of life?

Men often hesitate to expend money for any feature of a dwelling which will not add to its market value, if it should be sold. It is very proper to consider the contingencies which may render the sale of a homestead necessary, in the next generation, if not in this; but, at the same time, it is to be recollected, that the things which make it most desirable for the original possessor, those which fit it to him like a garment, are the very ones which will not suit a different person, and may not, willingly, be paid for. They ought to be provided with no expectation that they will ever return their cost, except by the greater value of the whole house to the builder himself.

After considering the purposes of building, we come to the investigation of the materials and methods of construction, by which these desired objects are to be secured.

To prevent heat from passing in or out of a house, the most effectual non-conductor is confined air. Of solid substances, the most valuable for this purpose are generally the most porous, or those having the greatest proportion of air confined in their interstices, and the worst are the heaviest and most compact. For this reason, sawdust, charcoal, tan-bark, &c., are used for filling in the walls of ice-houses, though often rendered inefficient by becoming saturated with water, which is comparatively a good conductor. A simple, hollow space in which air is confined between the inner and outer surfaces of a wall, is

the most effectual and readiest mode of rendering it impervious to heat, and it makes little difference how wide or how narrow the space is, if the air within is entirely cut off from escape or change. Whether the material is wood or masonry, every good wall, where the retention or exclusion of heat is an object, should be built in this way. It is as essential for summer as for winter; at the south as at the north. Care, however, must be taken that the inner portion of the wall is not massive enough to absorb so much heat as sensibly to affect the temperature of contiguous rooms.

A warm wall will almost always be a dry one. It is frequently, perhaps generally, thought that the moisture which stands on basement, and sometimes other exterior walls, is caused by water passing through them from the outside. A glance at a water pitcher, in a summer day, ought to correct such an opinion. If a wall is poorly built, it may become saturated with water, which shall escape by evaporation from the inside, and affect the air; or, in a severe rainstorm, it might, in rare instances, be driven through, so as to trickle down the inner surface; but in neither case would it show in the manner spoken of. If, as is sometimes said, the dampness is absorbed from the ground, the very capillary attraction which drew it into the masonry would hold it there. Moisture collected in this way is vapor from the air of the room, condensed by contact with a cold surface, and indicates both a bad atmosphere and a conducting wall.

Thick and solid masonry, of course, only aggravates the evil. The most damp and unwholesome rooms are found in buildings of the heaviest construction, where the substance of the structure acts as a great reservoir of caloric, receiving or giving out its supplies as the contiguous air, at different points or hours, may be warmer or colder than its own average temperature. This average does not differ greatly from the mean temperature, day and night, of the different seasons, and is considerably lower than that by day in the summer months.

In building cellar walls, stone will generally be used, where stones are found. They should, if practicable, be laid with a flat surface down, and made so solid as to keep out water and rats. Where it can be obtained readily, it will always pay to lay cellar walls with hydraulic cement, on account of solidity and durability. As coolness is desirable in a cellar, there is no occasion to make cellar walls otherwise than solid at the bottom. They will then always be just as warm as the earth around them. So far down, however, as they are exposed to the air, or in contact with earth liable to freeze, they may be so cold as to endanger the contents of the cellar, and should be protected by a coat of lathing and coarse plastering, formed on wooden strips, a little way from the stone work.

Brick walls for cellar purposes ought, whenever practicable, to be laid in hydraulic mortar, and, in most soils, covered with a perfect coating of cement on the outside, as they are otherwise liable to absorb so much water as to affect the atmosphere inside and to impair their durability. The foundation should be level, and care must be taken that the surface of the trench on which it stands shall not have been broken or disturbed.

If basement rooms are to be used for other than cellar purposes, it becomes necessary to make the walls double. When stone is used, this is to be done by "furring," with small wooden strips secured to the masonry and covered by lathing and plastering. Brick walls may either be furred in the same way, or laid as two separate walls, two or more inches apart, occasionally bound together by cross bricks, or, better, by small, flat iron bars; and then, if desired, the inner wall may be plastered directly on its surface. If openings are left into the air space, it greatly hastens the drying of the wall, but they should all be tightly closed when the work is done.

Such spaces are sometimes used as ventilating flues, with a total ignorance or disregard of their real value. Any ventilating or hot-air pipes which may be needed may very well be inserted in such spaces, but should be entirely shut off from the air cells. Another common mistake in building hollow walls, is making occasional vacancies, while the main part of the wall is solid, as though there were some virtue in the air, which would be diffused over the whole mass. The solid portions must be just as small as may be consistent with strength, for even a single bond-brick will often betray its position by a damp spot on the plastering.

Wherever hollow walls are used, whether above or below ground, the builder must remember that their purpose is not to save materials or cost, but to increase efficiency. He must not, as some do, make the entire thickness the same as if it were solid, filching the material from the middle, but must, for safety, add all the thickness of the air space, and spare no cost in the bonding, for safety is of prime importance. If properly built, a hollow wall is stronger than the same material laid solidly. There, nevertheless, are some things in the way of its universal adoption, and, except for the greater danger in case of fire, the preferable mode of securing the required air space is that by furring.

While we are below ground, let us examine the cellar bottom. If the ground is wet and springy, it will be necessary to cover it with a coat of concrete, made of coarse gravel and hydraulic cement an inch or two thick. Where the soil is dry, hard gravel, or even sand, will do, if the occupants are careful people; otherwise, it would be better concreted, so that it may be the more readily cleansed.

Foundations, other than cellar walls, ought always to be laid on hard ground, and below the deepest frost, according to soil and climate.

The choice of material for the walls of the superstructure is to be governed mainly by location. Good sense and good taste, never inconsistent, both say it should be the most substantial which can be procured with economy. Stone is undoubtedly the most suitable for any permanent building, when it, and the requisite lime, can be obtained of proper quality and wrought without too great labor and cost in comparison with other substances. Next to this is brick. One great obstacle to the use of stone has been the supposition that it must appear smooth, or it would look badly; and another, the difficulty of forming the heads and jambs of doors and windows. Both of these objections are obviated by using bricks in combination with the stone, where much accuracy of finish is required, or where openings are to be

covered. A simple surface of broken stone, such as can be gathered from the vicinity, suggests an unassuming control of the resources of the neighborhood, which no far-fetched material can show.

Stone walls ought always to be furred, and brick walls either furred or built hollow. It is best never to build any wooden blocks into the masonry, but, for nailing to, a thin strip may be occasionally laid in the mortar-joint, not more than two inches wide and less than half an inch thick. This will hold nails and will not weaken the walls. The ends of floor timbers are commonly built into the masonry, just as so many stones would be, but it is better, for the durability of the timber and the solidity of the wall, that, except on the bottom where they rest, they should touch nothing, a little space being left above them, and around their sides and ends.

Bricks, if used in the country, ought to be hard-burned, so that they may be left in their natural state, as much of the advantage of either brick or stone is lost if an external covering, demanding frequent renewal, is required for protection. It is useless to give any attention to outside cements, mastics, and plasterings of any name, since, while they are most objectionable for other than structural reasons, they form neither a permanent nor a cheap surface for exposed walls.

Next to brick in value, as a house material, is wood. Its great fault is the liability of burning. Its durability, when properly used and cared for, is perhaps as great as stone, in ordinary houses. There are many old buildings composed of both materials together, in which the wood is comparatively sound, while the stone is falling apart. It has many advantages, among which are warmth of walls, thinness, and lightness, and the rapidity with which it may be wrought.

There are many ways both of framing and covering wooden houses, each having its peculiar merits and defects. The earliest method was to construct the frame of square hewn timber, as large as could be handled conveniently, the joints being secured entirely with tenons and wooden pins. The braces were tenoned into the beams and posts, and were short, the strength of the frame depending mostly on the stiffness of the timber. The corner of a house framed in this style is represented in fig. 4. The weakness of such frames results from their apparent strength, the very weight of the timbers employed breaking them down. In such frames there is little regard paid to the direction of the strain which each piece is required to resist. Floor timbers are often used wider than their vertical thickness. Such floors sag of their own weight and vibrate with every step. Houses thus made are also sometimes blown out of the perpendicular, and lean in a seemingly threatening manner, the weight tending to increase their inclination. With such timbers, however, there may be considerable distortion without danger of actual breaking. The advantage of the method

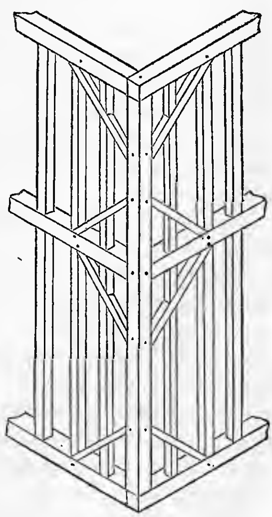

Fig. 4.

is chiefly its rudeness, few and simple tools only being used, and nothing but wood required for fastenings. It is cheap, where timber is plenty, but wasteful where it bears a market value.

The other extreme is the balloon frame, where no timber is used in the walls but vertical studs, of the smallest size that will answer to nail the covering to. Reliance is placed, chiefly, on the outside boarding, to keep the frame in its proper shape. Its advantages are its small cost, the ease of handling small timbers, the rapidity of its formation, and the fact that it does not need a mechanic to put it up. Its most prominent fault is the dependence put on nails—the most unreliable material of all that are used, even when new—and its liability to get out of place, and constantly grow weaker, by the corrosion of the nails and the wearing of the nail-holes. For small houses, and other buildings of light uses, it is a very suitable and valuable mode of construction.

In the best frames, there is no timber used beyond what is required, and each stick is so placed that its most effective strength is made available, the special use of every piece being considered, and its size and form adapted to it. Cross strains upon the wood are avoided wherever practicable, each piece resisting either compression or extension in the direction of its length. Where stiffness must be relied upon, the greatest advantage is taken of the edgewise strength of the timber, so that where, by the first-described plan, there would be floor timbers seven inches deep and perhaps ten inches broad, once in two feet, in this the timber would be ten inches deep, only two or three inches wide, and not more than sixteen inches apart. The weight is thus far less, and the strength and stiffness far greater. To keep such thin timbers from twisting out of place, there are bridging pieces, or braces, spiked between them, answering a much better purpose than an additional thickness of timber.

In this method, the timbers may all be much smaller than those formerly used, and still be stronger than the heavy frames. Being kept vertical by the braces, the studs may carry most of the weight. As the timbers on different sides generally meet the corner-posts at different levels, they may be as small as four inches by eight inches, or four inches by six inches, in many houses.

It is important that timber should be so arranged as to tie the frame as often as possible, and always to have a lateral pressure counteracted by a tie.

The most common thickness of wall timbers is four inches. This, in large buildings, is hardly enough to give all the strength of joints which is desirable, or the greater thickness for sash rendered necessary by the increase in the size of modern windows. Near large lumber markets, it is always cheaper to adopt such sizes as are in ordinary use and may be found ready prepared; but where timber is sawn expressly for any house, at least five inches thickness is preferable. In such cases, it will frequently save waste if all the framing plans are drawn before the timber is cut. Care should be taken, in seasoning it, to keep it straight; and the drying may be greatly hastened by frequent turning, &c.

One of the most durable coverings for a wooden house is boarding

vertically, the joints being protected by a narrow strip of batten. If the narrow boards are used, and the joints are tongued and grooved together, this is also one of the tightest and warmest coverings, but is not the cheapest, and has the disadvantage that, for nailing the boards, there must be horizontal timbering, additional to the vertical studs required for the interior lathing, and for support of the beams above. A modification of this kind of covering, very different in its appearance, is made by using quite narrow planks, an inch and a quarter thick, and omitting the battens. The same material may be used horizontally, but is better, if so used, with rebated joints, the outer lip being the thicker of the two, and the edges sloped a little downward.

Less costly than either of these is the common horizontal clapboarding, of which there are two forms, one of long pieces, uniform in thickness, except a shallow rebate at the lower edge, nailed directly on the frame; the other, of thinner boards, wedge-shaped in their section, laid upon a lining of rough boards. In cost the latter somewhat exceeds the other, but adds greatly to the stiffness of the frame, and produces a much tighter barrier to the weather, especially if between the lining and the clapboards, there is placed a sheathing of paper, which is now manufactured for that purpose, and is quite as efficient to exclude either wind or heat as another thickness of boards would be.

There is no more durable or warmer form of wooden covering than shingling of the best quality, laid on boards. If proper precaution is taken in selecting and preparing the materials, this kind of walling does not deserve the neglect and prejudice which seems to have befallen it, in late years.

Where it is customary to lay either clapboards or shingles on lining boards, walls are seldom filled in with bricks, an excellent practice, very prevalent in many localities. By "filling in," is not meant, however, "filling up," as some seem to suppose, who, in their inconsiderate desire to build thoroughly, use hard bricks, and lay them solidly, from the outer covering of the timber to the inner one, thus destroying the non-conducting air-space, which it is the very object to secure, and making the walls less valuable than if left with the simple boarding.

For this use, the best bricks are the softest from the kiln, only partially burned, and unfit for any other use. They should be laid on edge, in the center of the framing, so as to leave a space on each side, and must be secured in their place by an occasional board nailed in between the studs.

On the inside, the laths ought to be nailed once in sixteen inches—twelve is better—and at the corners those from both directions secured to the same support, so that there may be none of the angle cracks, which difigure so many good houses, in consequence of the shrinking of timber. The double air space made by the internal course of brickwork is useful to remedy imperfections in the outer or inner coating of the wall. The same purpose is sometimes accomplished by plastering roughly on laths fixed between the studs. A better way, because less likely to be rendered defective by shrinking, while affording an increased thickness of wall, very desirable at the windows, is to lath and

plaster roughly on the studs, in the usual manner, and then nail narrow strips of inch boards upon that surface, against each stud, and lath and plaster again.

Where neither bricks nor sound stones can be obtained, if timber is costly and lime cheap, a wall, answering a very good temporary purpose, may be built of concrete, which is a composition of lime and stones, so small that they are mixed into the mortar, and used without reference to their shape or position, the whole being formed in molds. Such walls need furring, as much as those made of bricks or stone, to render them warm, and must have, besides, a plastered surface exposed to the weather. They are inferior in every respect to a rough stone wall, and are said to be no cheaper, unless there may be a saving in the cartage of materials.

But exposed plaster surfaces must always be a vexation, until some cement is invented better than anything which all the centuries past have produced. Such devices have long been common, promising great things, deluding many, greatly corrupting public taste, substituting the fictitious and the flimsy for the true and the durable, and each, in turn, leaving a waste of dilapidation behind it, as it has gone out in disgrace, to be followed by another deceitful pretender of the same character.

It is greatly to be regretted that so much of the inventive genius of this age, both here and abroad, has been directed to the cheapening rather than the improvement of building. One half the thought and time and experiment which has been devoted to the production of imitations of stones, whose only merit, if successful, would have been that of appearing to be something better than they really were, or than those who used them were willing to pay for, would long ago have given the world a method of making the floors of ordinary dwellings fire-proof, and so little more expensive than wooden ones as to be within the means of every builder.

Let the workers in iron and cements, instead of counterfeiting with their materials more valuable substances and pushing them into uses for which they are nowise suitable, devise some way by which the supports of floors may be made as light and as strong of iron as of timber, and covered with a composition as elastic, as strong, as warm, and as durable as wood, and at the same time incombustible, and both shall be pronounced benefactors of mankind, and receive the commendations of all lovers of good architecture, instead of their execrations. Until something of this nature is devised, in common houses wood must be relied upon for the supports and surfaces of floors. They are greatly improved, but seldom, by a layer of clay or elastic mortar upon boards placed between the floor beams. This makes them less combustible. Similar measures may advantageously be used in the ceilings of upper rooms, which are close to flat roofs, to protect them from heat in summer.

What shall the roof be? If the object is solely to inclose the most cubic space with the smallest amount of material, the flatter the roof, and the more like a tea-chest the house is made, the better the object will be accomplished. Happily, however, there are some mechanical and financial obstacles to the execution of such an object. The cheapest

and most available roof-covering for isolated houses is shingling, or, in some favored localities, slating, and these both require a conspicuous elevation. The degree of slope is frequently determined by the carpenter for the ease of reckoning the length of rafters. It ought to be a well-considered matter, for, more than any other external feature, it defines the character of the house.

Upon parts of roofs it is, however, often desirable to have a much lower pitch than is suited for shingles, if good tinning work can be obtained. For such work, and for the gutters and valleys of roofs, the thinnest tin of the sort called "terne" or "leaded" plate, is considered more serviceable than the more costly kinds.

Of all the many cements introduced to notice within the last few years for the purpose of covering roofs, none have yet had a sufficiently long or severe trial to be pronounced perfectly reliable, and some have most certainly been proved worthless. Probably no one of them will accomplish what is claimed for it in all climates, but some of them may be found valuable for particular sections of the country when sufficiently tested. If so, they will, in many particulars, simplify the formation of roofs, and especially of their water-courses. Most if not all of them give an unpleasant character to rain-water, rendering them objectionable, if cisterns are to be relied upon.

The stability of partitions is promoted by resting those in the upper story directly upon the lower ones.

The warming of the house is a most important matter, and one which generally requires as much consideration in a southern house as in a northern one. The occasions for artificial heat being irregular and infrequent, are none the less imperative. In northern houses it is important that the chimneys should be in the interior of the building, that none of their heat may be lost. Flues are to be brought together, as much as practicable, in order that the heat of each may increase the draft in the others. Sometimes, too, the habits of the family and arrangement of the rooms are such that a part of the summer rooms are unoccupied in the winter season, at least for purposes requiring them to be warmed. But it is different where a sudden, chilly change of the weather, at any season of the year, affects people in every part of the house alike, and fires are demanded in each room. Their use being but temporary, the chimneys may be placed wherever they are most convenient, and open fires, on such occasions, at least, *seem* to be more effectual than any plan of close fire. In northern regions it is always easiest to warm an upper room from below, though, for special reasons, it may not always be expedient to do so.

Great outcry has been made against stoves, and they are undoubtedly liable to more abuse than open fires, and are certainly less cheerful; but there is no reason why we should not have the advantage of their very great economy, and still have wholesome and pure air to breathe.

And this suggests the vexed question of ventilation, which by some seems to be considered the cure for all life's ills. We all suffer too much from its neglect. Perhaps we should suffer less if it were less misunderstood. In the first place, we must remember that, except in the single matter of temperature, no system of ventilation, however perfect, can give us any better air than that which surrounds our house. If it

is damp or smoky, or in any way unpleasant or unwholesome, that within the walls must be the same. The most we can do is to warm it, if too cold, and to change it so frequently as to maintain a purity equal to that out of doors. These changes may be made by blowers and other mechanical means, out of the question in a country house, by the force of the wind, or by the ascending power of heated air.

The old way, so much favored by the lovers of open fires, was a combination of the last two plans. The air of the room, as fast as it as heated, ascended the great-throated chimney, and its place was supplied by cold winds through every crack. Nearly all the chimney caps and ventilators in use depend upon the wind for their efficiency. Blowing against inclined surfaces, the air is diverted upward, and thus produces an ascending current in the pipe to which the cap is attached. In breezy weather some of these devices operate excellently, but in a calm, of course, they are valueless. Their fault is similar to that

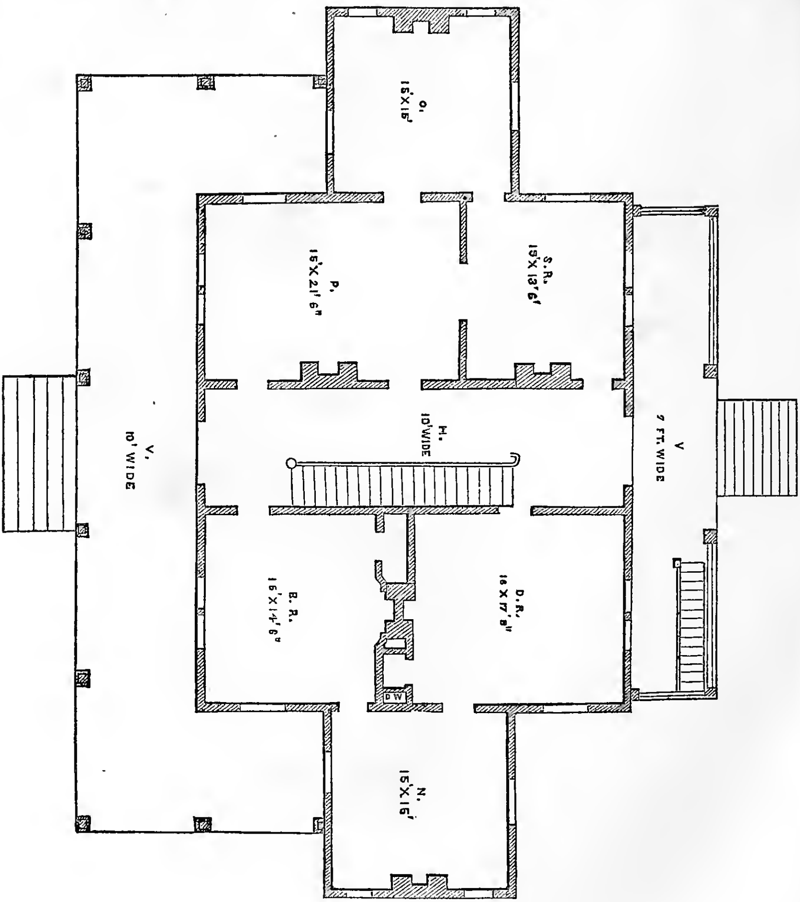

Fig. 5.
FIRST STORY PLAN

which the negro found with the moon, that it only shone in light nights, when it was not needed.

Doors and windows for summer or southern localities, will, in suitable weather, always be made use of as the most simple and thorough means of ventilation. Sometimes houses have been made, in the Southern States, with openings opposite to each other on all sides, through the entire building, so that in every direction there might be through drafts when there was a breeze. Nothing could be more delightful in pleasant weather. Figure 5 represents the principal floor plan of a house of this kind, built in Mississippi.*

But there are days when the outer air is too cool for comfort. Then our fires should, if possible, be so arranged that the external air shall be properly warmed as it comes in, and the vitiated air consumed or carried off in a regular flow, without unpleasant currents. Its ascending power must be made use to draw it off. It is not necessary, nor always best, to give outlets for air at the top of the room, as then it would be comfortably warmed with much more difficulty. A flue, formed of brick or metal, by the side of the kitchen smoke-flue, would always have an upward current of air, which would abundantly ventilate most kitchens, if an opening to it were made just higher than the doors. A similar air pipe on the other side of the flue might also draw off the foul air from the bottom of the cellar, though less rapidly. The cellar, indeed, might be well ventilated by a pipe from near the bottom, through which the kitchen fire should receive all its supply. What special arrangements may best be made to render the necessary fires in a house conducive to ventilation it is not appropriate here to consider. They are such as will make use of vitiated air drawn from just the proper point for feeding the fire, instead of taking the purest in the room, as at present is often the case, and will also make all the surplus heat of the smoke available in the formation of currents in contiguous pipes for the same purpose. Upon the same principle are the effects of the sun upon the roof and walls of a house to be rendered useful. The steep sides of the roof, receiving the sun's rays in the afternoon, absorb and radiate an amount of caloric that, if not properly disposed of, will in summer time render upper rooms intolerable. But, with proper arrangements, the air so heated may be allowed to ascend between the roof and the ceilings to the highest point, and there escape, drawing with it, to occupy the place it vacates, the heated air from any of the rooms below with which there may be communication. In this way the chambers under steep roofs are made more cool and pleasant than those next to flat or low roofs, though more exposed to the sun and less tolerable if not properly guarded.

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* In southern houses it is almost always preferred to place the kitchen and servants' rooms in a separate building, connected with the house by a short, covered passage-way, which may be inclosed or opened at pleasure. In this plan, the experiment of a basement kitchen was tried. It occupied the corner under the dining-room, access to it being had by the stairs in the rear verandah. An outside door also opened to an area under the nursery wing. A dumb waiter, which rose in the dining-room closet, also opened below to the same area, so that there was no direct connection between the kitchen and any other part of the house. For additional ventilation, there was a large opening in the kitchen ceiling, from which a wooden conductor led up between the chimney and dining-closet, and entered a flue in the chimney near the roof. (See fig. 2 for exterior.)

But all of these means of construction are unavailable without one other, and with that any of them may be used as desirable. In building, as much as in almost any other enterprise, there is profit in the possession of ready money and plenty of it. Little, miserly savings, which do not, altogether, make a perceptible reduction in the first cost, are the very things that take away most from the real value of a house. Afterwards, you will wish you had obtained this true value, even at many times the original expense.

One of the greatest and most frequent mistakes in building is, attempting to accomplish too much with the funds provided. It will not do to fix on the size and quality of your house, and also to limit your expenditures, with ordinary judgment of the cost of building. Nor, if a friend capable of advising you in the matter, tells you the money is too little for the house, or the house too large for the money, must you think he is trying to persuade you into extravagance. Probably the truth is just the reverse. If you cannot understand why a house no larger than the one you want should cost so much, do not, for that reason, disbelieve the fact, if those who assure you of it have better opportunities of knowing than yourself. It is better to be informed before the money is spent, than to find it out afterwards. Probably the reason is that you desire additions or alterations, which seem to be insignificant, but which materially change the plan from that which you have adopted as a standard of cost. If your purse is limited, you must restrain your ambition. It is not wise to attempt to get more for your money than it is worth, in ordinary circumstances. If you try to drive hard bargains, ten to one you will be the one cheated, and the occupants of your house will suffer for it as long as it stands, even if in the end it does not cost you more money than it would if fairly built at a fair price. Build well, doing what is done so that it will last, curtailing the dimensions of the house, if necessary, to fit it to the money to be spent, trusting to the future for enlargement, rather than spread a little money over a great extent—none of which will ever be worth the trouble it has cost.

Much additional value may be given to any structure in the country, by a prudent foresight in the selection, preparation, and preservation of materials, previous to the commencement of the actual work. In clearing ground of stones, there may be encountered many better suited for peculiar uses in foundations, if saved, than any which could be found if specially sought. There are few who appreciate another means which their own lands afford of enriching and beautifying their edifices, without expenditure of money, in a way which money alone cannot imitate. There is hardly a wood that grows that cannot be used advantageously and ornamentally in its own native color in house building. The variety of these is very great. On many single farms there may be found from twenty-five to thirty-five different kinds of wood, all suitable for parts of the interior finish. The balusters of stair-railings, for instance, might be not only more striking and more appropriate, but more beautiful than any imported wood, if they were made of different native woods in their own natural grain, and arranged with reference to the contrast of colors. A log saved from a

fruit or shade tree, when one is sacrificed for any reason, will occasion but little trouble to lay up, but could hardly be procured on demand.

As soon as the plan of the house is so far decided on as to warrant their purchase, the lumber and timber for its construction should be seasoning. Too much haste in erecting the house will inevitably show its effects in cracks and twists and gaping joints when too late to provide an entire remedy.

In arranging and combining the means at command, so as to meet as fully as possible the wants of the family, without waste of material in the first instance, or causing an unnecessary expenditure of time and labor in the future, there is much occasion for both study and experience. As each man commonly builds but one house, and has no opportunity to correct his errors, he is liable to encounter difficulties, or fall into mistakes, that have troubled hundreds before him, who have, too late, learned how to avoid them. The number and uses of the apartments being determined, they are to be combined and arranged with reference to convenience of communication between them, their exposure and prospects, and the exterior shape of the edifice, involving the form of the roof, spacing of windows, &c. It will be seen that there are many diverse and sometimes conflicting purposes, all to be kept in view, and difficulties to be reconciled, that may well perplex one unaccustomed to the work. It is impossible to lay down rules for designing a house, but some points to be regarded, in judging of plans, may be designated.

The rooms should be compared with others, of nearly the same size, devoted to similar purposes, and furnished in nearly the same manner. Every one understands that unfurnished rooms seem to be of very different dimensions from the same apartments when occupied; and the room which, as a bed-room, may seem large, will look very small as a parlor.

The size and shape of many rooms must be regulated by the furniture that they are to contain. The bed-room *must* have space for the bedstead to be placed without interfering with doors, or it is valueless. The eating-room must, at least, have width enough for the table, with its chairs, and passage-way on either side. If a piano is to be accommodated in the parlor, the requisite space must be provided for it, without crowding it upon the hearth, or closing up an important door, or a window.

The height of stories has an important influence in determining the apparent size of the apartments. The old houses were uncomfortably low. Following the fashion set in cities, there is a tendency to the other extreme, and rooms are often rendered cheerless by an unreasonable height. Besides the useless cost involved, and the unfavorable effect on the appearance of the house, it causes great inconvenience at stairways. The stairs are tedious to ascend, and occupy so much room in each story as to interfere with doors and passages. For any house in which the largest rooms are not more than sixteen feet wide, a greater height of story than eleven feet is seldom, if ever, advisable, while smaller houses, and upper stories, may range from eight or nine feet upward, the former being as low as sleeping rooms ought to be made.

When men sit down to sketch an arrangement of rooms, &c., the staircase is almost always treated as a subordinate feature, which may be crowded into any corner, otherwise unoccupied; and too often the same feeling controls its actual construction. In a good staircase, the steps will be broad and not too high, and there will be room enough for the tallest person to pass without even a seeming danger of hitting.

The ease of stairs depends, not entirely upon the height of the step, but on the proportion which the rise bears to the breadth of the tread. The dimensions which, perhaps, are most suitable for country houses, are seven and a half inches rise, and ten inches width of tread. If the rise is increased, the breadth may be diminished, so as to keep the product of the two dimensions, when multiplied together, near seventy-five. These sizes must be often varied with the height and the room which may be occupied, but, in good stairways, the rise ought to be less than eight inches. It will be seen that the room occupied is more than is sometimes thought necessary. If the story is ten feet high, a straight staircase would cover a space of the lower floor more than thirteen feet long, and require a well-hole in the second nearly eleven feet long. To bring the head of the stairs near the center of the house, it is common to have a platform a few steps down from the top. In high stories, this allows more available room below, while it occupies more of the room of the second story than if there is but one ascent. To accomplish the same object, and to save room, winding stairs are used, but are always to be avoided, where possible, as each step is reckoned at twice the cost of a straight one, and is never pleasant, or safe, after it is up.

The stairs, forming the connection between the upper and lower parts of the dwelling, may contribute much to its cheerful and united appearance, by showing themselves to be easy, capacious, open and inviting. If in sight, they always form an agreeable feature, unless the story to which they lead is itself so uncomfortable that any suggestion of it is repulsive. For saving labor, and for the protection of carpets and furniture, a back flight, ascending near the kitchen, and shut off by a door at the bottom, is, however, required in most country houses.

The arrangement of doors is often such that, without some caution, two or more, in opening, interfere with each other. But care in regard to the hanging of them will prevent much of the annoyance. This is a matter generally left to the carpenter's journeyman, who hangs the doors with more reference to the right or left hand make of the latches he has, than to any other consideration.

Attention has so often been directed to the fact that the solid contents of a cube are greater than those of any other right-angled figure of equal surface, that most people, following Loudon, and those who have copied from him, seem to consider it an axiom, that any departure from a perfect parallelogram, in the form of a house, is at a sacrifice of economy. Some have carried their mathematics still further, and urged that everything should be formed in octagons. As appendages to single rooms, octagonal forms are sometimes both convenient and pleasing to the sight, especially when it is desirable to obtain light, or views in more than one direction, or to secure entrances

at corners of rooms; but for an area to be divided, there is no shape more inconvenient or wasteful than this. The rooms can have no regular form, without the sacrifice of many triangular spaces, alike useless, whether inclosed or not. There is little chance to place ordinary furniture, the connection of room is inconvenient, the house, externally, is as unsightly as it is possible to make it, while the greatly increased amount of partitions usually runs its cost up to or above that of a rectangular building of the same capacity. People who have occasion to pack square goods, do not choose casks for the purpose.

For the economy of building and economy of living, the general form of houses must be rectangular, but it need not be a square nor a regular parallelogram; because *a b c* is just as long as *a d c*, it takes no more wall for a square house than an irregular one of the same extreme dimensions, the floors and roof being all the additional expense. It is therefore said that the square one is the most valuable one for its cost. This is not true, if the room so taken in is not needed or cannot be used to advantage, or if the addition materially impairs the value of the original structure.

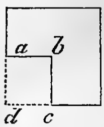

Fig. 6.

Irregularities are frequently desirable to afford light to special parts of the interior. The construction of the roof sometimes demands a change of form, and sometimes it is required for the improvement of the general proportion and outline of the building. In the little cottage represented in figures 7 and 8 the entry communicates, without waste of space, with each of the three rooms. If the corner in

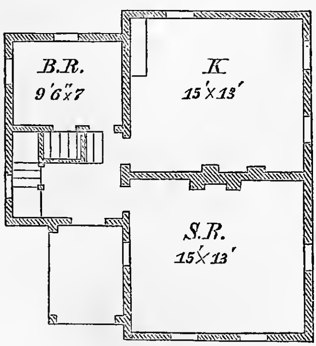

Fig. 7. First story.

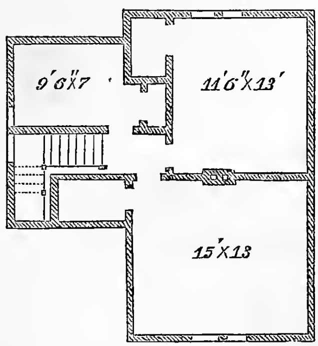

Fig. 8. Second story.

front of it were filled out, it would still be necessary to carry the hall back as far as it now extends, so that the room would only be useful for entrance purposes. The side window of the sitting room would be lost, and so would the advantage of the snug corner for the entrance and veranda. The roof would require an entire change, and the whole arrangement and appearance of the exterior would be different. Look at the perspective view, (figure 9,) fancy its modifications, and say whether it would be better to make them, at the additional cost of floors and roof, for the sake of the greater entry which would have been secured.

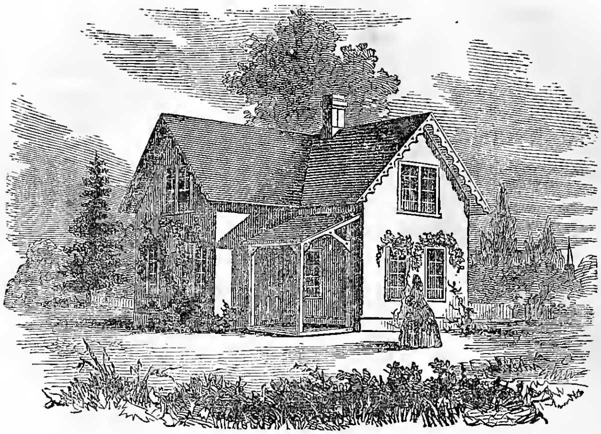

Fig. 9.

That there shall be the best expression of consistency and completeness, the structure must be centralized. Some one prominent feature must be above or before the rest, and first fix the attention. The whole form must tend toward this, so that it shall seem one united design, grown up together. In the best of the old rectangular houses the high roof and central chimneys served this purpose. In the best modern ones, not only the roof, but the different parts of the house, each telling of its own purpose and use, group themselves around some central point—central in influence rather than position, and to the charm of simplicity and unity, add the greater charm of variety. The two resemble each other in their development of symmetry very much as the trim evergreen and the well-formed oak.

Every feature of a house that tells of a use, essential to the enjoyment of home, may be valuable and pleasing in its exterior, and the higher the nature of the enjoyment secured by it the more valuable the indication. All such things are to be so arranged and exhibited as not to interfere with each other in their effects. For this reason it is proper to keep in view the exterior expression, as well as material convenience, in arranging the interior.

The chief expressive features of dwellings are the windows, entrances, roof, and chimneys, to which may be added the verandas.

The windows are the eyes of the house, not only giving light and cheerfulness, but telling, more than any other feature, what is going on within. Although the form of windows is infinitely variable in the other classes of architecture, there can seldom be much, if any, deviation from rectangular outlines in houses of the class under consideration. If the walls are built of bricks, or small stones, the heads may be arched with advantage, both in the construction and appearance. But the requirement of light as high as possible in the room restricts us to the low segment, as the only available form of arch, and this varies so little from a straight line that, though the opening of the masonry is curved, the sash is often straight. In wooden walls curved forms over openings are manifestly not the most appropriate, being

both weaker and more costly than straight ones. But there is opportunity for much variety even with rectangular windows.

In houses, such as all have seen, with five windows on the front, up stairs, all placed at equal distances, and four windows and a central door below, we have what is by many considered the perfection of regularity and order. Such regularity is of the lowest kind. The door betokens some entrance way, but, besides that, there is nothing to indicate the internal divisions or uses of the house, or, when looking at the upper part, to fix the attention on any of the uniform windows. A very little alteration will at once change the whole front, and, without impairing its symmetry, give it a new character. Let the two windows on each side of the middle be placed nearer to each other, so that they shall always be looked on as a pair, and the house at once is seen to have a room at each end. If the middle window has a size or form peculiar to itself, it may also give dignity to the center, and thus, without extra cost, and without change of the walls or roof, a very important expression may be obtained.

The gathering of the windows together has also served another purpose. Before, the walls were broken up by numerous openings, so that they had a scattered and restless look. Now, the breadth of the unbroken wall-spaces is increased, and the apparent weight and solidity of the structure, and we have contributed much to the feeling of stability and repose, which is essential to domestic quiet. The windows may be brought close to each other, forming one double window, or separated by a wider or narrower pier, according to the circumstances and the judgment of the designer, the center of the two being, if practicable, in the center of the apartment, and those of the upper story above those of the lower.

Difference in the size and shape of windows on the same front is not only allowable, but pleasing, when there is a good and evident reason for the diversity, as, for instance, against stairways, the location of which may, very properly, be shown in that way, instead of hidden by false or useless openings, uniform with the rest in size and situation. Windows in the different parts of the house may be almost any size, and grouped in a thousand ways, giving great variety and expression to the house, and at the same time contributing to variety and interior convenience, if the whole proportion of opening to wall-space is maintained, and the central points of the groups are so placed as to retain the balance of the parts nearly as though they were all alike.

There is nothing that gives a house a more uncomfortable look than the little, low holes under the eaves, which are sometimes called attic windows. They give evidence that a space, too contracted even to be more than barely endurable, is, nevertheless, occupied by somebody, whose light comes from an opening close to the floor, rendered inaccessible by the lowness of the roof. A window in the gable, on the other hand, may seem very pleasant, as it gives no evidence that the room from which it looks out extends on either side so far as to be uncomfortably low.

Dormer windows, if broad, on steep roofs, are really very pleasant features of rooms that may be far more comfortable and cheerful than many lower down in the house, but if the roof is comparatively flat,

and the windows are narrow, they afford, at best, but a sorry avenue for the light of day; and in either case, their appearance expresses the truth of the matter.

Figures 10 and 11 representing an alteration of a small house, illustrate these suggestions respecting windows, and some other matters, soon to be alluded to.

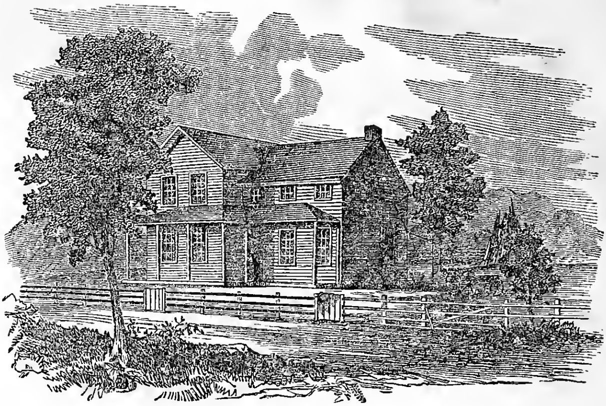

Fig. 10.

People whose knowledge of French windows, or those whose sashes are hinged like doors, is derived from seeing them on an occasional visit to a neighbor's, are often very anxious to have them on their own houses, and it is with difficulty they are persuaded that they are in anywise objectionable. Unless made very heavy, and with at least twice the work and cost required by an ordinary sash-window, they cannot be rendered even tolerably tight against storms under verandas. In exposed situations rain will drive in, notwithstanding every precaution. Such sashes cannot safely be used with curtains, as many housekeepers know, by vexatious experience. Another serious objection to them is the broad bar up and down the center, where unobstructed light is most wanted; but in its apish mimicry, fashion has fastened the

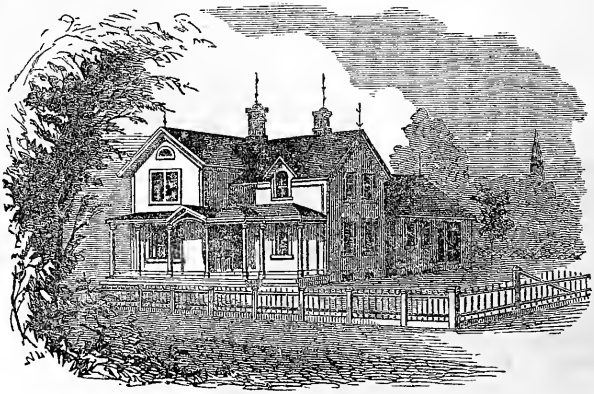

Fig. 11.

objectionable feature on windows of other construction, where it is entirely uncalled for and a nuisance.

Is it necessary to say anything of those most inexcusable lies called sham windows? They are confessions that the builder thinks he ought to have placed a window where he did not; attempts to falsify and hide the real character of the building he was incompetent to manage.

The man who is not ingenious enough to avoid even the apparent occasion for sham windows, wooden chimney tops, and all that sort of falsehood, is unqualified to design a house for human habitation.

The warmth of windows may be increased by doubling the glass. This may be done either by putting two thicknesses in one sash, or by placing an extra sash outside in winter.

As the windows are the features chiefly tributary to the internal cheerfulness, so the doors are the means by which communication is maintained with the outside world. The main entrance should open into a hall, or passage, communicating directly with the rooms where visitors would be received. It should be spacious and accessible from the front, for convenience, and should be sufficiently prominent to be inviting, and appear hospitable, but not so obtrusive as to promise more than the rest of the house will warrant. All outside doors ought to be sheltered by porches covering the steps, so that a person awaiting entrance may not be exposed to storm or sun. The back porches may be very plain and inexpensive. If the doors are not otherwise protected within the building, these may very well be so constructed that, in the winter, they may be inclosed with movable shutters, inserted between the posts. It is best, however, that no outside doors should open directly into any of the living rooms of the house, and in cold climates it is well to have them shut off by an extra door from the passages in common use. If no better provision can be made, a temporary partition and door, of light frame-work covered with some woven stuff, to be placed across the hall a few feet from an outside door, in the winter, will contribute greatly to the warmth of the house, and need not be unsightly.

The front porch, being for protection against storm, should be as heavy and substantial in appearance as the general construction of the whole building. It should be neither flimsy nor disproportionately massive. Upon stone and brick buildings it should be made much heavier, both in form and detail, than would be at all proper upon wooden ones. It may, with great propriety, receive as high a degree of ornamentation as any part of the structure.

Verandas, on the other hand, being simply shades, and shelters from the damps of evening, ought to be and appear as light as is consistent with stability. Very unpleasant effects have been produced by constructing them as modified porticoes, with columns and cornices of classic type, but horribly distorted in proportion. They are, in their uses, unlike anything to be found in ancient architecture, resembling awnings rather than roofs, and should be managed as a peculiarity of our own time, without attempting to follow an inapplicable model. Porticoes carry weight of roof on heavy columns, frequently placed so that the columns and the mass above are the main features. Verandas carry little weight; their supports must be far apart, and should seem

light and fanciful, the part above being a mere screen. The chief effect of verandas, architecturally speaking, is the dark shadow beneath them.

The English seem to consider these features mere matters of ornament. They may be so in that climate, but in ours are of great practical utility. Their position should be chosen with reference to their usefulness, as well as the symmetry of the building. As a shade, a veranda is useless on the north side of a house, but its roof is a protection against the effects of falling dew; and in the afternoon, when the horizontal rays of the sun render the south or west side untenable, the north may be a desirable resort. Judgment must be employed that it be not too narrow for free use, or too high for shade, or too wide or too low for light. An agreeable tone may be given to the light by a delicate tint on the veranda ceiling.

Sometimes the main porch is combined with the veranda, or, rather, the entrance is from a veranda without any distinct porch. Unless the veranda is quite small, it is best in such cases that some change in its form should be made, so as to render the entrance more prominent than it can be under an unbroken line of roof.

Any attempt to give expression to a dwelling will be nearly useless if it have a characterless roof. This is the head of the house, and, more than all other features, gives it peculiarity. Its varieties and effects can only be hinted at.

A flat roof, or one so low as to be invisible, may be a cover to the building, but is not a roof, to outward sight. The house can never seem to be finished which is apparently lacking this most important member. It should be so steep as to be seen at the ordinary distance at which the house will be looked at, but the slope should not be so long as to make the entire height too great when seen from further off; for then the roof seems to crush and distort the building below it. If the width of the house be very great, it will generally be necessary to have two slopes to meet these two requirements, one steep near the walls and a lower one further up. The upper slope may, if proper materials can be obtained, be nearly flat.

The gables, or the pointed walls where roofs terminate, are very marked objects, and the roof ought to be so formed that these shall make the central and commanding feature in the principal fronts. The general tendency of the roof lines should be towards the center, uniting the whole structure, and concentrating the attention. Hipped roofs, where the slopes of sides at right angles to each other meet, contribute greatly to this effect; but gables are generally needed in combination with them, both for light in the garret and for satisfactory appearance. The form commonly built a few years ago, with a long, unbroken roof, sloping to and from the road, with enormous gables at each end, was the reverse of this, scattering rather than concentrating in its effect. Gables may appropriately surmount the projecting parts of the house, wherever an irregular form is adopted. As the slope of the roof is to be the same on all sides, the width and position of projections and the form of the roof influence each other.

The cornice may be considered a part of the roof. In the simplest and rudest construction, where thatch or rough slabs are used as a cov-

ering, the roof always projects beyond the walls, both at the ends and sides, as the most ready method of affording protection from the weather. Such a projection is essential to the expression of the full value of the roof. It also suggests another idea, more fanciful, perhaps, but one which influences every person more or less, that of sheltering or brooding the house. As our experience in discerning character is mainly derived from the observation of the human face, we very early learn to trace resemblances in other things, and it may be that our feeling respecting cornices is suggested by the similarity to the hair and eyebrows, which are so essential to the character of the countenance.

A flat-roofed house with a wide cornice—a form "fashionable" of late—is simply a box with a cover too large for it; the two have no peculiar relation to each other, and no apparent union. But *our* roof and cornice must fit our house only. The walls must be finished for it, and show the fact, not seeming to have been built higher and cut down, but prepared for stopping, by belts, &c., before the roof was reached. Then the projection must be proportioned to the height and width of the walls, and extent and thickness of roof, so that while it is enough for a shadow, breaking the outline, and for real protection of the walls, it shall not seem to be in danger of breaking off, nor entirely stop the eye of the observer, in running up to the summit of the house. For the last reason, the moldings of the cornice must be easy, and the square surfaces against which their curved lines stop not too broad. Brackets, too, though not essential, are serviceable to the

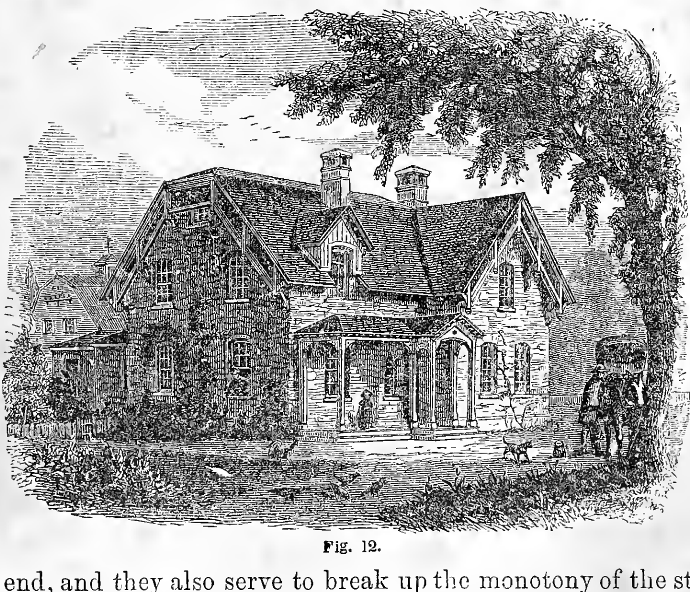

Fig. 12.

same end, and they also serve to break up the monotony of the straight cornice lines. Unless there is some special purpose to be served by grouping them, it is better to place them at uniform distances apart, equally distributing their apparent and real load, than in pairs, as some do, for reasons unknown.

Upon small and steep gables, not allowing of great projection, and

in certain styles, the same effects are produced by a plank hung under the cornice, called a verge-board, which may be varied indefinitely, either in its outline or by perforations. The faults of this kind of finish are the liability that, instead of a substantial plank, with a visible thickness, some thin, flimsy board will be used, of which only the front can be seen, and that the forms chosen will not be such as to aid in the desired effect. It is a safe rule for those who are not artists, in all matters of this kind, where figures are to be represented by flat surfaces, to use none but simple geometric figures, or the graceful outlines of leaves and other natural objects that are themselves flat.

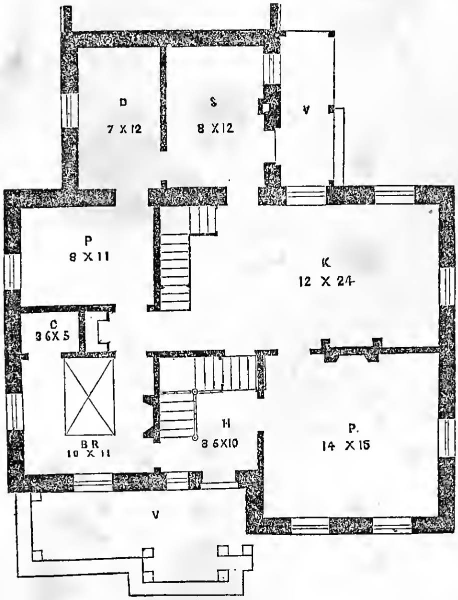

Fig. 13.
FIRST STORY.

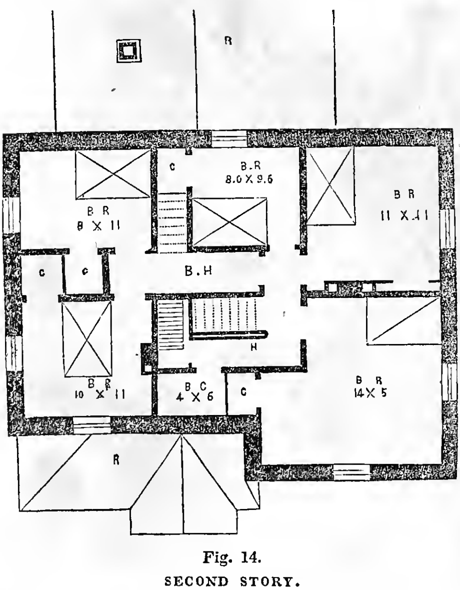

Fig. 14.
SECOND STORY.

Whatever features of roof or cornice are adopted, let them be real. Mock gables, which are not the actual terminations of roofs, like all other building fictions, excite disgust with the whole structure.

The chimneys, which crown the whole edifice, may make or mar its influence most seriously. Fortunately, the position which produces the best result externally is the one on all accounts most suitable, considered solely with reference to the interior economy; and modifications of form in the chimney tops, sufficient for all ordinary embellishment, need hardly make an appreciable addition to the cost, and may, at the same time, increase their practical utility.

Figures 12, 13, and 14 illustrate some of these ideas. They represent a design for a small stone dairy farm-house, where all the rooms are intended for daily use.

The sitting-room, or parlor, P (Fig. 13), and the kitchen, both connect with the front hall. The scullery S., dairy D., and store room P., are large, and so is the kitchen. In the second story there are five chambers.

The tops may show, by an ingenious disposition of the bricks, that care is bestowed and variety sought even in the working of the coarsest and most intractable materials. Placing them in central positions, so that they shall form the apex of the general pyramidal outline, they will be more conveniently located for collecting several flues into a single stack, more economical in original construction, and both more efficient and economical in the use of fuel than if built in the outer walls.

When so situated, they seem to tell of families gathered together, rather than dispersed to the four corners of the habitation, as always seems to be the case in those houses, which are often seen, with lean, tall, uncared-for shafts all around the building, rising hardly so high as the ridge of the roof. The favorite phrase of orators, "around the family hearth," has something more than a figurative significance, which is everywhere recognized. The size of the chimney tops may also suggest either generous fires or the contrary. A small, single flue may practically serve all the purposes of carrying the smoke from a stove-pipe, but it will always indicate its fuel-saving, rather than its heating qualities. Yet, if too large, chimneys fail again, by reminding of the overgrown and badly constructed fire-places, that carried off immense quantities of hot-air, but produced little effect inside the house, except in the way of cold draughts and rheumatism.

It is with chimneys as with all other parts of an edifice, if they are to express anything it must be in a language understood by those to whom the expression is to be conveyed. So much regard must be had to common customs that the associations of those who are to see the house shall aid rather than counteract your efforts. We need not, however, yield to opinions and habits of judgment founded on a familiarity with bad models of buildings, or the prevalence of a thoughtless fashion.

Neither are we bound to make the reason for all our details, and the manner by which they produce their effects, obvious. The world may read our communications without knowing how their characters were impressed. A structure which has received the study of its builder is worth the study of the beholder, and it is not our business to encourage his laziness.

With wooden buildings, an important question always arises, respecting the color of the painting. There is nothing on which it is more difficult to communicate definite ideas, as no one in words can describe a color so that another shall be able exactly to match it, even with the most careful cultivation. The difficulties are greatly increased when either party has not made this a subject of study. It is always presumptuous to attempt the statement of rules on a matter involving such diversity of choice. It is safe to say, however, that a clear and glaring white is not so desirable for "house paint" as some softer tint, unless the sole purpose is to make the building conspicuous; that no somber or dismal color should be chosen; that it should be one not liable to fade disagreeably; that, in shaded positions, it will bear to be much lighter than in exposed; and that the different parts of the building should not be painted in violent contrast to each other. It is quite customary to heighten the effect of some of the outside details,

by giving them a darker shade than the rest of the surface. This is, indeed, almost necessary on a clap-boarded house, to counteract the effect of the horizontal lines of shadow, which, like the parallel tint lines of engravings, make the whole clap-boarded surface seem a shade

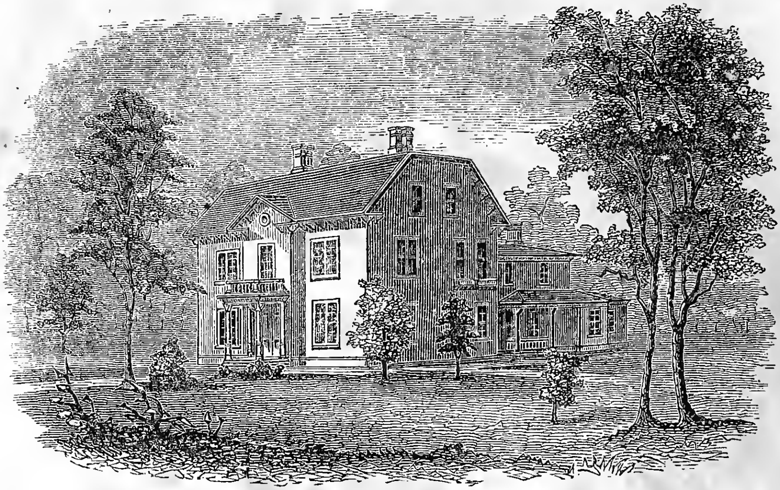

Fig. 15.

darker, from a little distance, than the plain parts. But it will not do to rely on difference of color for the effect of details, in planning them, as all portions may sometimes be painted alike.

On the interior wood-work, two or more tints of the same color may be used, about doors, &c., with very pleasing effects, if the variation is not too great and the color not too dark. The meanest work which ever finds its way into decent houses is what is called graining. The only superiority claimed for it over plain painting, is the greater ease of keeping it clean—due not to the graining, but the varnish on the surface. This may as well be put over any paint; or, if the color of the natural wood is desired, the paint may be left off altogether, and the real article presented, without the disgrace of a sham. For there is no incongruity, but a manifest propriety, in using all these materials in the same structure, if, in their own places, they each serve a better purpose than any other could. There ought to be no attempt to conceal their real nature, but, on the other hand, each, in its form and finish, should be wrought in its own most appropriate manner. If, however, stone would be better than wood for the purpose to be served, and the latter is manifestly a substitution of a cheap and imperfect material for the better one, it ought not to be used at all.

If none of the harder woods can be conveniently employed, common pine, if left unpainted, would be superior in beauty to the most perfect imitation of oak or walnut ever attempted.

The colors of stone and brick, when used together, should be considered in their arrangement so as to produce harmonious variety or pleasant contrasts, and such parts as are of wood be painted different from both, that no one may imagine there is any attempt to imitate either.

It is not intended here to enter into any general examination of the buildings of a farm, except the farmer's own residence. But the influence of these structures upon the home occupations and home comforts of a farmer's family is so great, that in some respects their arrange-

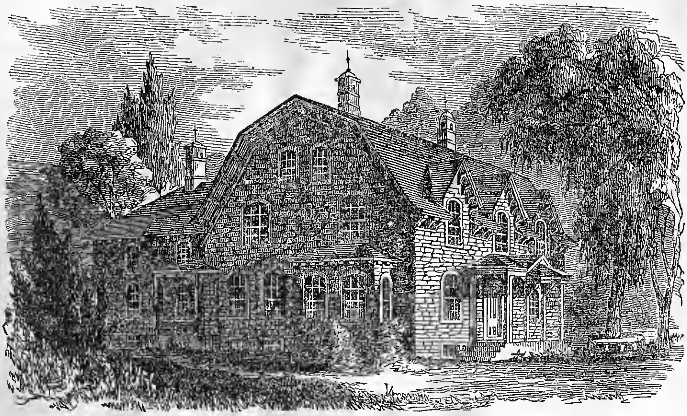

Fig. 16.

ments are not less important in this view than those of the house itself. Aside from all questions of personal convenience, there is nothing in the whole system and policy of agriculture that can be made to contribute more to the facility and profit of the labor to be performed than the barns and other outbuildings. Their number and extent is generally not so great in this country as is deemed requisite upon the same amount of land in Europe, although in some sections hay is housed, and seldom so abroad. But a most common sight here is a disorderly collection of carts, plows, harrows, sleds, and other appliances for farm-work, exposed by the road-side or in the stable-yard to all the vicissitudes of the weather, while such things are carefully housed in sheds specially built for them in the improved English farmsteads. Although the machinery which in English establishments is provided for grinding grain and preparing food for cattle is generally not needed by American farmers, there are many things in which they might profit by the example set on the other side of the water; but in nothing more than in respect to neatness and orderly management, there regarded as a matter of profit, and which here, also, would bring great accessions to the enjoyments of country life. The same principles of design and construction apply to these buildings that are to be observed in the dwelling-house, and in very many respects their application will be the same, while in other matters it will be modified by the difference of circumstances and the peculiar demands of the structure. We cannot refer to details, but must content ourselves with a simple indication of some of the ends to be sought, rather than the means of obtaining them.

Whatever may be the preference respecting the use of stone for farm dwellings, there can be no question that it is the best material for many of the outbuildings. Many times it can be collected without any expense beyond what would be incurred in clearing the stones from the fields. The labor of laying walls is such as may in a

great measure be done by farm hands when not otherwise occupied. The whole cost may be more than that of a frail wooden structure, but it will be vastly more durable than the generality of such buildings. If basements are used, which are required to be dry or warm, the same precautions are to be taken as in the house, only that boards may be employed instead of plastering.

If barns are constructed of wood, the framing must be in some respects different from the house, because strains are unequal at different times in such buildings. The thin timbers, which answer perfectly for the walls of a house, would not be sufficient to resist the outward pressure of hay. Sometimes, too, there are weights thrown upon beams never designed to carry them, and unless they are much stronger than is necessary for any duty expected of them, they may, in such circumstances, give way and cause disaster.

Why need barns be built more than a low story from the ground where land is of no comparative value? It seems as though an intelligent farmer might save himself much labor in pitching hay at a time of the year when labor is the best worth saving, by planning his barn so that his hay need not be raised above the ground floor.

In stables there ought to be a plentiful and constant supply of water. If no other can be had, the roofs afford the means of collecting large quantities of rain-water. In many situations it might be carried by pipes to cisterns but little lower than the roof, either built on the ground or above, from which supplies might be drawn for the barn or house.

Light is as indispensable in stables as in bed-rooms, if proper regard is paid to the condition and comfort of cattle. Where glass is sold no higher than in this country, it is simply shameful to keep horses in dark stalls to save the expense of a window.

Foul air is no more wholesome for cattle than for men, and is much more easily got rid of in stables than in houses. To do so, involves the necessity of neatness as a habit.

There should be somewhere a shop, where tools may be kept in order, for making little repairs to harness or tools, without delay or loss by neglect.

Orderly arrangement and division of the buildings, so that the litter or stench, of one part of the barn shall not extend over parts where it is unnecessary, can easily be accomplished, and is worth attention. Harness should have a place where it may be kept in order, instead of hanging in the way, behind or beside the horses; but it need not be in the feed-room, and it may, perhaps, be disposed of better than by tumbling it in a heap upon a straw-cutter or in a wagon-box.

The defects of American farm establishments are, probably, most noticeable in the management of the manure deposit. It was very common, in certain parts of the country, to see, a few years ago—and such things may be found, perchance, even now—barns placed directly across the highway from the house, stables ranged along the road, and manure heaps piled against the side of the building, where every rain, as it fell from the roof, would drop upon them, bespattering the wall and washing away, in offensive streams, the very substance most needed for the fertility of the farm. But little better are the establishments

where the stable doors are only accessible through barn yards, which are perpetual sloughs of mud and filth. In these things, as in most others, the course which is furthest from neatness and comfort is the most unprofitable.

There are men who always travel with the odor of the stable clinging to their boots, whose coming can be foretold in the distance, but whose departure does not remove the evidence of their late presence. Their houses, from garret to cellar, are redolent of their occupation. A cleanly woman, in such a house, is an object of pity. Many of them have patiently borne what was to them a serious and real hardship, rather than, by complaining, incur the charge of discontent with their proper sphere of life, as though industry and filth were inseparable!

This is entirely unnecessary. The stables may be so ventilated and contrived, and the cattle-yards so drained, that this nuisance may be avoided, with profit at the barn, as well as comfort at the house. To disregard this incessant disgust of a sensitive woman, because the olfactories of her more stolid husband are not so acute, is scarcely less than brutal.

If a census could be taken of the merchants and business men in our large cities who are most active in their occupations, and the most noted for wealth and enterprise, it would be found that a very large proportion of them look forward to a home upon a farm, to which they may sometime retire from the avocations of commerce, as the goal of their ambition. Comparatively few ever reach it, and they only after the habits of a lifetime have unfitted them for its enjoyment. At the same time, the singular spectacle is presented, of whole neighborhoods deserted by farmers' sons, and their places supplied by inferior and hired laborers. What drives these young men from agriculture to other employments? Is it the hard work of a farm? Most of them encounter more labor, physical as well as mental, than would be necessary on the land. Is it constant work? They find no relief in that respect who engage in trade or enter a profession. Is it the wish for a more honorable avocation? None such exists. But is it not the disgusting things which they wish to escape; the disregard of the obvious advantages, and neglect of the best means which a farmer's life affords for the development of his own better faculties, which is seen on every hand?

Our whole subject has an economic bearing. It has, also, relations to art and to morals, the former subordinate to and included in the latter. It is not a mechanical topic alone, but is worthy the investigation of the philanthropist and the patriot.

GREEN SOILING STOCK.

BY D. S. CURTIS, OF MADISON, WISCONSIN.

By green soiling, or "soiling stock," is meant the practice of keeping all the animals in stalls and yards, and feeding them on *green food*, raised and cut for the purpose, during the ordinary pasturing season, and then allowing them to run only in the yard a short time daily, where they can take necessary exercise, instead of following the old-fashioned or ordinary custom of permitting them to range the fields or "commons" for the purposes of pasturing in the usual manner.

To present some reliable information on the practice and results of this system, derived from observation, experience, and reading, is the object of this paper.

Observing persons, who have had much experience in tilling the soil, know well, that it will yield much more value of product, when wisely manured, worked, and reaped, several times during the season, than if cropped but once, or pastured by animals running at large.

The question then arises, will the *extra product*, obtained by thorough tillage and repeated gatherings by man, remunerate the *extra labor and expense* required by this process, over and above the ordinary benefits obtained from the same quantity of land, by pasturing it with the amount of stock which can fairly be maintained upon it, with simple pasturage during the summer, and cutting feed for them during the winter.

It is believed that this question can be not only demonstrated affirmatively, but it can be clearly shown that the system will pay, *several times over*, even in the new States, where lands are cheap and plenty, as well as in the older States, where land is dearer, and farms smaller.

FENCES AND HERDING.

In the prairie districts of the West and South, where fencing timber is scarce and expensive, farmers are compelled to resort to various expedients for securing the usual conveniences of fences. Ditches, sod-fences, and hedges, are the most common substitutes, all of which are, more or less, useful, particularly the latter, wherever the climate or season will permit their robust growth; but all of them demand considerable labor and trouble, first to make them, and then to keep them in repair, while none of them are always sure to "turn cattle," and protect the crops. Wire fences, also, are frequently employed to advantage; but they, like the others, are more or less insecure.

On some very large plantations, fences are almost wholly dispensed with, and, in their stead, men or boys are engaged, night and day, to pass continually around and watch the fields; while, on some other farms, the stock is herded by a keeper in day time, and yarded at

night; and, on a very large scale, these modes are found cheaper than making large outlay for a great quantity of fences.

But in all of these cases there must be much insecurity to the crops, and more or less danger of losing the cattle, so that none of these expedients can be entirely relied upon for general use in any highly cultivated region, while boards and rails are expensive in the prairie district. Hence, in order to obtain the largest benefits from agriculture of which it is capable, farmers must adopt some other and better system of managing their stock and lands, and herein that better way will be pointed out.

ADVANTAGES OF SOILING.

Green soiling is the system which will admirably meet all these wants, if generally practiced, even in the prairie region and stock-raising districts.

To begin with: Suppose a man of quite moderate means obtains and settles upon an eighty-acre lot, the size which generally constitutes the smaller farms of this region; he has a yoke of oxen, two cows, and two or three young hogs, for fattening and for breeding. In the start, he is able to inclose half of it, forty acres, with a fence of some sort, which requires $80 \times 4 = 320$ rods of fence; the cheapest and most economical kind within his reach is a ditch and sod-fence, which he can make with his own hands, and not pay out a dollar of money; and if well done, will cost him one day's work for every five rods of the fence, say $70; and this is the best he *can* do, if unable to hire help or buy fencing stuff.

This accomplished, he yet has but one field inclosed, and this much he could not well dispense with, unless *all* of his neighbors kept their stock safely fenced in. And, with his forty acres "fenced in," he still has no secure pasture for his cows, team, or hogs, but must let them *run out*, and range the commons, to any distance they will, over the unfenced prairies, and waste his time and theirs in being hunted up. This much he *must* submit to, the first season, upon his new farm, unless he can procure a store of food for his stock, or make more fence to confine them near home, but the very labor and expense required for additional interior fences would be sufficient to pay for their necessary food. And, with very little labor, he could make a temporary shed and yard for them comfortable enough for the warm season, which could be improved and made more comfortable on the approach of winter; thus he would be economically and pleasantly provided for until his new crops grow to his use, which need not be longer than about the first of July, if he early sowed a small patch of oats, or corn, (broadcast,) or millet, peas, or any other crop of which he may happen to have the seed, which will furnish a cut of succulent feed in early summer, and grow rapidly at this season of the year.

This he can mow or cradle daily in sufficient quantities to supply his animals in their stalls or yards, from which he need have no further trouble than to work his team in raising crops, cleaning his fields, and feeding his animals at suitable times, say three to five times a day, as circumstances will permit. Some feed their milch cows six times a

day, and think the benefits more than compensate for it. This first patch will last until another one, which was sowed fifteen or twenty days later, comes on; thus a succession of feed is furnished.

Now, the case supposed, being a new farm in a new country, is one of the worst that well could be for favorably showing the advantages of "soiling." But the animals are *now* all safe, where they will not destroy the crops nor cause the owner vexatious *loss-time* in tedious hours of looking after his strays, far away over the boundless prairies, and the little new farm is in a condition to begin to enjoy the fullest advantages of "soiling," in practicing which with care and calculation, devoting more labor to less land, giving the same time to care for his stock in the stable which is often spent in chasing them, early and late, when strayed away or unwilling to be catched, the owner will realize greater profits, as well as delight, in his business; and if he will but labor nearly as hard, in hauling out and spreading the manure saved at the stables upon his land, as he does in making his cross-fences, he will be sure to obtain larger returns from his cows and land than he would by the old system.

This first season past, and all the "fodder" being saved for winter which can be on a new place, the next thing to be done is to plow and prepare as much ground as can be well done, or the weather will permit, for the following spring's crops. Then, as early as the condition of the land will allow, in the spring (which is often as early as the latter part of March, but still oftener the forepart of April) a piece of *oats* should be sown—at least three bushels to the acre—and be well harrowed in; about *half an acre* to *each head* of stock to be fed, and *half an acre* for *all* of the hogs. This, for the two cows, two oxen, and the hogs, will require *two and a half acres*. In ten or fifteen days sow, broadcast, of corn, millet, or the like, another half acre to each head, two to three bushels to the acre. Sorghum, buckwheat, or peas, will be good, if the seed is at hand, to give variety of feed.

These two *sowings* will allow a rich and abundant supply of feed to all of the animals for two months, at least; the green oats to be mowed or cradled day by day, as the stock may need, for July, and the corn or other crop to be cut in the same manner, as it may be needed, for August.

But for the early part of the season—before these sowed crops come on for cutting, about the last of June or first of July—the stock will continue to be supplied by the winter feed, such as straw, hay, and roots, together with cuttings of the earliest *grass* which makes its appearance large enough for the scythe, and with *clover*, when it is introduced on to the farm.

For September the stock can be fed with the *second* cutting of oats and the early grass, which, on rich, mellow land, will be pretty rank and large by this time if it were not cut too close down the first time. For October they can be fed on the *second* cutting of corn and other crops that may be ready, together with the *first cutting* of those that were *sowed last*. Barley, and even peas, are a good crop for late sowing, which may be as late as in the early part of June, as they are better calculated to stand the early autumn frosts than most others which we have named.

On deep-plowed, mellow ground, well manured, these crops will grow on thriftily, and admit of two or three cuttings before the frosts kill them in the fall.

This "soiling" on very rich fields, is often practiced by milkmen who keep large numbers of cows near populous cities or towns, where they wish to feed a good deal from little land; they sow corn or millet, or other like crop, and about as often as once a month they mow it, and carry the feed to the cows in their stables; and they find it very profitable. Their course is, as often as every ten or fifteen days, as the feed is cut off and consumed, to re-plow and sow, after first spreading all the manure from the cow stables, as fast as made, for re-cutting and feeding. In this manner, with care and system, they regularly obtain the equivalent of three or four rich crops in a single season, and find that *one square rod of ground* furnishes an ample supply of the richest feed for a cow one day, and maintains the fullest flow of rich milk. And these valuable results may as easily be realized by farmers, with the same care and effort, upon every acre of land which they will cultivate on the soiling system; and certainly it must be more safe and agreeable than toiling and tugging over large fields, which are made to produce not more than half their real capacity under the best management.

But returning to the farm: November will be well provided for by the last cutting of the soiling crops, together with the *tops* of such *roots* as have been raised, and are gathered about or a little before this time, which make a rich and much relished food for animals at this season of the year, and promoting the yield of milk. Any excess of feed from the several crops which may happen to exist, can be cured and stored away like other hay or straw—all the better if mixed in the hay with the latter—for winter "fodder."

In addition to these come *roots* as the chief and best feed for winter, cut up with straw, hay, and stalks, and given to the animals in mixture, which is sure to keep them in good heart, flesh, and milk, until the next spring, the usual time to commence pasture, when the order of "soiling" is resumed, and pursued about as pointed out above; of course, with such modifications as experience or circumstances may dictate; and, like a merchant with a comfortable deposit of currency in the bank, upon which he can draw at convenience, the farmer *now* has an equally rich bank upon which he can draw for sure treasures, in the shape of the good pile of manure which has been made during winter.

And here it will be seen that less than *seven acres of land*—less than *two acres per head*—under this improved management, maintained, in most comfortable and thrifty condition, the two cows, two oxen, and the hogs, in both winter and summer, and with additional comfort to the owner, there being no milking or feeding out of doors in storms, mud, or hot sun, and no racing through fields and over the commons for cows, team, or pigs.

Under the more common custom of cultivation and pasturing, from five to eight, and even ten acres per head, is usually required to get well through the year, with hardly half the quantity of manure saved, and at more than double the cost and outlay of capital in land and

fences. But with the "soiling" system generally prevailing, farmers really need to have no more fence than to inclose the outside or boundaries of the farms; with, perhaps, a handsome inclosure around the residences and gardens, with good barn-yards adjoining the stock stables.

FARM SUPPLY AND ROOTS.

In the meantime, sufficient ground is plowed and prepared upon which to raise such other crops as are necessary for the farm, and the family may need, or other circumstances may render desirable; and a sufficient quantity of land is sowed to *roots,* of some kind, to furnish ample food for the animals through the winter, after and before soiling. One bushel a day of carrots, beets, parsnips, or turnips, per head for each animal to be fed, for about five months, is a liberal allowance, and a safe calculation in providing roots for stock. Some of them will eat more than that quantity, but more of them will eat less. One bushel of roots cut up with a little straw, hay, or stalks, is all-sufficient to keep the largest cow fat and in full milk, if kept in a warm stable, while most of them will not eat that much; but it is safer to provide that quantity, if it can be done. For a working horse, one bushel of carrots, or half a bushel with the meal of a half peck of oats, cut up with a reasonable quantity of straw or hay, will keep him in good heart and working condition, under fair daily labor; many horses require even less, while very few ever need more. Carrots are the better and favorite kind of roots for horses, and most people *seem* not to understand the value of that fine root as horse feed, from their not using it more largely, while it is cheaper than oats by half.

Both horses and cattle, supplied all the year round with this rich succulent food, are seldom sick or ailing, but always in good flesh and sleek, shining coats—being never "hide-bound"—because never heart-bound nor frost-bound.

On the above estimate, or rather well-tested data, for the five months of December, January, February, March, and April, one hundred and fifty bushels of roots will be required for each animal, which, at a moderate yield, would require the product of only one-quarter of an acre; or, of one and a quarter acres, for all of the stock which we have designated, on the eighty-acre farm above.

Where the land is rich, mellow, and clean, and the crop is thoroughly cultivated, with good seed, 600 to 800 bushels of carrots and parsnips, and 800 to 1,000 bushels of beets and turnips to the acre, is only a good crop, and can safely be calculated upon, while a much larger than this is often obtained, at remunerating rates, under high culture and manuring. But the estimate above, for feeding, is based upon the smallest yield, of only 600 bushels to the acre.

COULD DISPENSE WITH MOST FENCES.

The interest on the out-lay for fences, with the expense for necessary annual repairs, where a farm is as well fenced as a *fenced farm* ought to be, would nearly or quite equal the cost of the extra labor of raising

and delivering the food to stock in the stalls, under a well-conducted system of "soiling," to say nothing of the superior comfort of working with teams, plows, and other implements, in broad fields, where there are no obstructions from interior fences and hedges, which, moreover, cause loss of time, and waste of the valuable acres of land which they occupy.

And, in fact, if this custom of "soiling" or feeding *all* stock in stables or yards *were universal*, there would be no need of any other fences than those along the highways and around yards, as before suggested. It would work an admirable *revolution* in general agricultural operations, and effect a saving of millions of dollars in every State, and even in some single counties, in the mere matter of fences alone, which are subject to constant decay and waste, and entirely useless, save for this one purpose of protecting crops from the depredations of outside animals, and which can be so easily dispensed with, and with no sacrifice of convenience to the farmer; but, on the contrary, with absolutely enhanced comfort and profit, by avoiding the great *loss of time*, of both man and team, so often suffered, in not having the cattle or horses on hand at *early morning* or other times, when most needed. *This* loss, alone, during the year, with many persons, amounts to enough to go far towards raising their summer's feed, when judiciously applied; besides the vexation and "wear and tear of spirit," which would also be prevented by pursuing this "better way." All farmers who have ever experienced or witnessed the profitless annoyance of having teams "strayed off," just when much wanted, and not found until the "heat of the day," and then man and beast "all tired out," will appreciate the force of this point right keenly. Besides, there is a pleasure in always having *all* the animals at hand, whenever wanted for inspection, sale, or use, and being quiet and gentle, from constant handling, they can be more pleasantly and carefully examined. This is an interesting thought to the kind and enlightened stock grower.

COST OF BOARD FENCES.

In many portions of Illinois and Wisconsin, the most ordinary plain board fences cost from eight to ten shillings per rod, and even more in many places, while often rail fences are still more costly, but taking the lowest cost, of one dollar per rod, the expense of inclosing any eighty-acre lot would be four hundred and eighty dollars, and two cross-fences, one each way, throwing the lot into four twenty-acre fields, would cost two hundred and forty dollars more—in all, seven hundred and twenty dollars, a larger sum than the value of the land itself in many locations; in fact, there are many farms, in all parts of the country, on which the fences really cost more than the worth of the land; of which, the annual decay and cost for repairs are about as much as the taxes against the whole property. Now, retaining the boundary fences, and excluding the cross or field ones, this two hundred and forty dollars, with expense and waste, is saved for more profitable investment in some other department.

DOCILITY OF ANIMALS.

As has been previously hinted at, the systematic handling, at regular times, of all the stock—cattle as well as horses, in and out of their stables—so familiarizes them to their keepers that they become pleasantly acquainted with each other, which affords increased confidence in both, and thereby the animals become docile and tractable, and the owner comes soon to understand well their wants, nature, peculiarities, and diseases—if they have any, which is very seldom—and how to treat them successfully. Thus, the management of stock, generally, is reduced to a science, eliciting study, observation, and reflection, and by thus exercising the intellectual faculties, the business becomes far more interesting, as well as profitable.

Knowing and appreciating the animals more highly, the keeper is moved to treat them rationally and with increased kindness, which really constitutes him a better man and them better servants!

Were *such* the only advantages to be derived from the soiling process to the humane lover of knowledge, they of themselves would be rich compensation for all of the additional attention required to practice it. Besides, the stock can be more judiciously supplied, with more comfort to them, the food being readily selected, as to kind and quantity, agreeably to their particular wants; and the owner is happily relieved from the annoyance of "breechy" depredations by "unruly" cattle, which often commit more destruction in a single day or night than their own worth, to say nothing of the damaging effects to his own temper and equanimity, which, oftentimes, considerably abridges both profits and enjoyment. This should lead to those higher reflections and more beneficent impulses which it were well should enter into all of our transactions, with either men or animals who are always to be our companions or servants.

With these reflections, we will proceed to point out the more direct and pecuniary benefits of the practice, as they have been abundantly proved by the various experience of enlightened operators on both sides of the Atlantic.

NINE DISTINCT BENEFITS.

We can now sum up, clearly, nine principal advantages that may be surely derived from the faithful practice of this beautiful system of *green soiling the stock* of the farm, besides the incidental benefits which grow out of it indirectly, namely:

Saving of land; saving of fences; saving of food; improved condition and comfort of all the animals; larger product of milk and flesh; greater docility of the animals; freedom from breechy depredations; larger accumulations of manure; and increased order in all the business of the farm.

Incidental to these, will be greater cleanliness throughout the premises, there being few foul fence-corners, and no feed or manure scattered about under foot; a greater variety of food can be used, and everything saved; allowing the convenience of doing more of the work by one's

self, and requiring the paying out of less money; and permitting the sale of a larger portion of all grain and fruit, or other *matured* products that may be raised on the place, and be desired in the usual market; and the comfort of doing a much larger share of the ordinary business under shelter; and having a much larger amount of *value concentrated* in a comparatively smaller space, thoughout most of the farm property and products; as, for instance, one hundred dollars' worth of stock or grain occupies much less space than the same value in land or fences, and a hundred dollars' worth of wool or butter less space than the same value of grain.

LARGER CROPS REQUIRE GREATER MANURING.

It is true, that this process of extreme cropping makes severe drafts upon the capacities of the soil, and requires corresponding liberality in supplies of manures; yet, the superior product much more than pays for the extra requirements of manure and labor, as surely as the well-fed horse returns better service than the poorly-fed one does.

And all experiments and observations prove that the quantity of manures, made and secured from the stock which eats this produce, if all properly applied to the land, is sufficient to keep up its productiveness to the highest point demanded by the system, so long as it is pursued, and even enough to keep much more land in high tilth.

Now, taking these two propositions together—namely, that the land thus treated and often cropped yields far more than it otherwise would, and much more than pays the cost; and that the stock fed upon it produces more than manure enough to keep up the soil to this state—we are prepared to assume, that it is more advantageous to maintain stock on this plan than to allow them the range of much more land. And this fact will hold true as well with large farms as with small ones, and in new countries as in old ones; for, in either case, capital in lands and fences is saved to a large extent. "Soiling" will make every acre that is used employ more labor and stock, and give a greater return for them, besides employing both more pleasantly, than the pasturing custom possibly can!

But, it may be declared by some, that "in *new* countries," thinly settled, where there is unlimited range of pasture, it will *not pay* to raise and cut crops to feed out to stock in stalls, when they can so readily run and have what they need "for the picking of it themselves." Though this idea is generally believed and indulged by emigrants to the new States, it is nevertheless fallacious, and is successfully answered in previous remarks upon the *new* eighty-acre farm. It will cost no more *to raise the feed* for stock on the farm at home, *because* there happens to be a *large range*, than if it did not exist; while the cost and loss of chasing the stock *is greater* than if the range were *small!* It is proper to remark, in this connection, that there are some peculiarities about the prairies of the South and West which require a different mode of cultivation in some respects, from that commonly pursued in other portions of the country, and which have been presented in the volume of the Report for 1858, at page 283, written by myself, and a

reference to which may render it unnecessary to repeat them at this time.

But we may repeat, that whatever reasonable course or policy will secure the same return for *less labor*, without depreciating the capital, must certainly be peculiarly a good system for a *new country*, where labor is scarce.

HIGHER INFLUENCES OF THE SYSTEM.

When thoughtfully considered, it will be seen that the general effect of this practice upon the mind of the operator will be elevating and salutary. This branch of his business absolutely requiring constant *gentleness* and *order*, his *general* habits and feelings will naturally become imbued with similar principles and sentiments toward everything with which he comes in contact, to a much larger degree than *could* be under the ordinary mode of imperfectly and carelessly cultivating large farms, and allowing the stock to run at large, often trampling under foot and destroying as much good feed as they consume, and subjecting the keeper often to harassment in chasing after his half-tamed animals; his own disposition, as well as theirs, getting badly "riled-up," interrupting his tranquillity and happiness for hours or longer; causing him, in some measure, to lose his kindly interest in them; and, as though it were a kind of natural reflex from his own condition upon them, they do not thrive so well as they ought, but being frightened and excited they, too, *fret away* some portion of their *thrift*—serenity being as essential to the highest product of milch cows and fattening animals, as to the enjoyment of man. The very opposite from the above is the case where all the animals are quietly secured and amply fed; comfort and order reigns; and there being little or no disturbing cause to man or beast, the former seldom maltreats the latter; and all enjoy thrift and progress to the highest reasonable degree.

This to some, with only partial reflection, may be deemed but a trifling consideration; but the more thoughtful and observing operator well knows that no attitude of mind, in the farmer or other person, can be productive of more enjoyment and prosperity than the steady preservation of gentleness and serenity; it is certainly a manly, a noble deportment, and must ultimately be as profitable as it is pleasant.

In addition to all this, the operator will uniformly find this frame of thought and mind far more favorable for reflection and investigation into the causes of all the various phenomena which constantly come before his observation in the pursuit of his business, and to enable him to extract therefrom more elevated enjoyments than can be experienced by the person who is constantly confused by disorder and excitement from surrounding circumstances. Order and tranquillity are eminently essential to deep and efficient thought and the successful pursuit for knowledge everywhere, but especially so in the study and examinations of living creatures.

Besides, many of the neighborhood quarrels and individual enmities are engendered by damages and trespasses committed by cattle running at large, and often terminating in lawsuits, that subject both parties

to losses, in time and money, greater than the value of the damages and animals combined; all of which would have been comfortably avoided under the general prevalence of "soiling" the animals in *secure stalls.*

GENERAL VIEW OF THE SUBJECT.

Whatever is conducive to order and thoroughness in its operations must be advantageous to the pursuit of agriculture, generally, in all regions; and to forward that object, is the sole and earnest purpose of writing this article.

That process which increases the fertility of the soil, while it preserves its productiveness, and which secures the highest remuneration to the largest amount of labor, with the least depreciation of the capital upon which it is employed; whatever accomplishes these ends, or any of them, in one State, must be good policy also in any other, while the like results follow the operation.

Now, it is well known that land, which is liberally enriched by suitable manures, will produce much more bulk and value of succulent feed if the crop be frequently cut off, before it ripens or matures, than if left to attain that complete state before it is cut at all. For instance, if a field, which is mellow and in high tilth, sowed with corn, or oats, or millet, or other like crop, be mowed two or three times during its growing season, it will yield at least twice as much as if cut but once in that season. So with clover, and the ordinary meadow grasses. This results in obedience to a pervading law in vegetable growth, which continually strives to reproduce or perpetuate itself so long as the season for growing will permit, and winter holds off.

If meadows are sufficiently rich, and kept annually top-dressed with fine manures, they will yield two to three tons of good hay at *one* mowing in the season; bu if cut *three times*, at periods properly chosen, during the season, they will yield four to six tons of still better hay than that obtained at one cutting. And instances are numerous where even twice that quantity has been obtained to the acre from timothy and red-top, or even blue-grass meadows. These statements are sustained by testimony, both in this country and Europe, of early as well as recent date.

There is a prevalent belief among many cultivators, that for a "stock-farm," or to keep a large number of cattle, it is absolutely necessary to have a large farm, or a vast tract of land; an opinion, it is believed, not well founded, which a fair understanding of the plan and results of "soiling" plainly shows, for it is evident that the cost of additional land and fences demands more capital by far to pasture large herds and flocks, than is required to cultivate sufficient crops from less land to feed them with in stalls and yards, where no feed is wasted and much manure is saved. The accumulation of *acres* increases taxes, but their enhanced *fertility* does not increase the amount of taxes.

By taking the facts, results, and operations above elicited, and carefully and honestly making estimates, in comparison with ordinary farming anywhere, it is believed that every candid inquirer will arrive at the conclusions stated above.

SOILING AND ROOTS IN ENGLAND.

Soiling cattle has proved highly advantageous in Europe and the older States of this country in all the instances where it has been adopted, and it may also be made profitable in the new States, even where land is cheap and population sparse, and thereby much of the hardest labor, incident to new settlements, be avoided; for even the usual labor of making the inside fences, where timber is plenty even, can be more profitable and pleasantly appropriated in raising feed and giving it to the animals in a proper manner; and surely the latter will be the lighter toil of the two!

But, to show what may be accomplished on a given quantity of land, when the full amount of labor and manure which it is capable of receiving is applied, a quotation is made from the statement of Murwen, a distinguished cultivator in England, a few years ago, on the subject of soiling and rotation:

"On 894 acres of land he applied 13,700 loads of good manure on the whole field, at a cost of $12 per acre; he paid a rent of $12 per acre; and the labor, taxes, implements, interest, &c., cost another $12 per acre; amounting to a total expenditure of $36 per acre, and of about $31,000 on the whole farm. Then, the value of the entire product was, in round numbers, £8,600, or about $43,000; leaving the handsome profit of about $12,000 on the cultivation of the farm for the year; affording an interest on the investment of over thirty-eight per cent, and of about $13 50 per acre;" an achievement which may be contemplated with profit by many who seem content with $3 profit per acre!

Among European agriculturists, *root crops* have become an important staple in their improved husbandry, and play an important part in the "soiling" process, furnishing the largest and best portion of the winter's feed. And there is no doubt, from countless trials, that good ground, with proper manure and culture, will yield a greater quantity to the acre of nutritious food for animals in roots than in any other crop, whether for milk or flesh. Instances are numerous in this country and Europe, where 1,100 bushels of carrots, the same of parsnips, and 1,300 bushels of beets and of turnips, to the acre, have been obtained. In England, turnips and parsnips are the favorites; while in France, beets and carrots are more used; and in this country they may all be used with inestimable profits!

Besides their large nutriment and productiveness, roots possess much value, from the fact that they can be sown and will mature later in the season than almost anything else which the farmer raises; even after the ground has been cleared of some other summer "soiling" crop, a good yield of turnips may be raised and got off before the frost closes the ground; and then they leave the field in a clean, mellow condition, to be used the following spring or summer, with whatever crop it may be desirable to occupy it with. The work of digging and gathering them is about equal to one plowing for the ground.

Having once engaged in the practice of "soiling," every farmer, who has method and calculation enough to carry on his business suc-

cessfully, will discover, readily, such special modifications as will be most appropriate and beneficial for his particular case; as what succulent it is best for him to put in for the particular kind of stock which he desires to feed; what lands, and how much *he* needs to devote to each animal; what animals it is desirable for him to keep; together with suggestions in regard to the requirements of the markets that may be accessible to him; but still, in regard to the *prime principle*, that *all animals* should be *kept up*, and *all feed* be gathered and regularly given to them in the *stalls* or yard, there can hardly be two opinions; and to convince those most interested of its truth and economy, only needs that the facts and directions contained in this essay should be thoughtfully examined, and if not satisfied, it will cost no one much time or trouble, or subject him to the slightest danger of loss, to make the experiment with a single animal, or on a single quarter of an acre, or for a single season; it will not, in anywise, require a hazardous or expensive experiment to test the subject; while, agreeably to uniform testimony thus far, a highly beneficial lesson will be learned, and the conviction be confirmed.

MR. QUINCY'S STATEMENT.

In our own country the most thorough and successful operator in the system of "green soiling," and who may be regarded the father of its practice, in New England, was the Hon. Josiah Quincy, of Massachusetts. He has been followed with admirable success by his son, Josiah Quincy, Esq. And I cannot do a better service to those who may desire to give attention to the subject, in any other way, than by copying a few paragraphs from an essay by him, showing the results for many years of their experiments in "soiling," from which others can learn the general system, and make such changes in the order of operations as their individual cases and localities and their respective peculiarities may seem to render necessary. Mr. Quincy says:

"My farm being compact, the annoyance of having fifteen or twenty head of cattle driven night and morning to and from the pasture; the loss of time in often turning the team and plow, owing to the number of interior fences, and the loss of surface of good land capable of being plowed, owing to them and the many head lands, all drew my attention to the subject of 'soiling' and its effects.

"I found that European writers maintained that *six* distinct advantages were to be obtained by the practice of 'soiling,' over that of pasturing cattle in the summer season:

"1. It saved land;

"2. It saved fences;

"3. It economized food;

"4. It kept cattle in better condition and greater comfort;

"5. It produced more milk; and

"6. It increased the quantity and quality of manure;"

To the above advantages enumerated by Mr. Quincy, observation, with some experience, warrants the addition of three more distinct benefits that may surely be derived from a faithful practice of this

system, which have been, in part, described in the foregoing pages, namely:

7. Better discipline and docility of the animals;
8. Freedom from breechy depredations; and
9. Increased order in all business about the farm.

These last three items are more particularly realized in those sections of country where less care and attention have been given to the improvement of stock, and consequently less orderly habits prevail among the animals, and less method in the business. Incidentally to this will be felt the benefits of having the various animals always at hand when they may be desired.

Mr. Quincy proceeds: "Satisfied in my own mind of the beneficial effects of the practice, I adopted it in the year 1814, and adhered to it until the year 1822, keeping from fifteen to twenty head of milch cows, with some other stock, and with entire satisfactory success." "From that time, being occupied in various public offices, in Boston and vicinity, I exercised no superintendence over my farm for twenty years."

"Resuming its management in 1847, I returned to the practice of 'soiling.' Since then, I have kept from thirty to thirty-five head of milch cows in this way; so that, in my mind, my experience is conclusive on the subject."

He says that *one acre soiled* from will produce at least as much as *three* acres pastured in the usual way, and that "there is no proposition in Nature more true than that any good farmer may maintain upon *thirty acres* of good arable land, *twenty head* of *cattle* the year round, in better condition, and greater comfort to the animals, with more profit, less labor, less trouble, and less cash advance for himself than he at the present mode expends upon a hundred acres." He further says: "My own experience has always been *less* than this, never having exceeded *seventeen acres* for *twenty* head."

"To produce a sufficient quantity and succession of succulent food—about one and a half or two square rods of ground to each cow to be soiled—sow as follows:

"As early in April as the state of the land will permit, which is usually between the 5th and 10th, on properly-prepared land, oats at the rate of four bushels to the acre.

"About the 20th of the same month sow, either oats or barley, at the same rate per acre, in like quantity and proportions.

"Early in May sow, in like manner, either of the above grains.

"Between the 10th and 20th of May sow Indian corn, (southern dent being best,) in drills, three bushels to the acre, in like quantity and proportions.

"About the 25th of May sow corn, in like manner and proportions.

"About the 5th of June repeat the sowing of corn, as above.

"After the last-mentioned sowing, barley should be sown in the above-mentioned quantity and proportions, in following successions, on the 15th and 25th of June, and in the first week in July, barley being the best qualified to resist the early frosts."

In Illinois and southern Wisconsin it will often happen that the ground will do to sow as early as the 20th of March, occasionally even

earlier, while somewhat less seed—say three bushels—will answer fully as well. In this region, millet, Hungarian grass, sorghum, and spring rye, have proved to be good crops for soiling; the sorghum being particularly useful for the late or second sowing, late in June.

Corn, too, at the West and South, may profitably be sown ten or fifteen days earlier than the dates indicated for New England, and will do well sown broadcast, instead of with the drill, on mellow, clean ground, if thoroughly harrowed both ways, and all the better if well rolled after the sowing.

These various provisions for a variety of crops will supply food something in the following order, viz:

"The oats, sown early in April, will be ready to cut, for soiling, between the 1st and 15th of July, and will usually remain succulent until about the middle of the month.

"Those sown about the 20th of April will be ready to cut between the 15th and 20th of July, and will last nearly or quite till the 1st of August.

"Those sown early in May will be ready to succeed the preceding, and will last till near the middle of August.

"The corn, sown on the 10th and 25th of May and early in June, will supply, in succession, excellent food till early in September.

"The barley, sown in July, will continue a sufficient supply of good feed until the 1st of November, when, as sometimes before, the *tops* of roots—as carrots, beets, and turnips, with cabbages—are a never-failing resource."

Generally, in the southern and western regions, these crops can be sown, and consequently will be ready to cut, ten to fifteen days earlier than mentioned by Mr. Quincy for the climate of Massachusetts.

"Reduced to a single statement, my experience and system is, for the support of my soiled stock during the months of July, August, and September, to sow in the months of April, May, June, and July, equal to *three quarters of an acre for each head* of cattle to be soiled, in such order as will give a regular succession of succulent food during the three first-mentioned months.

"For their support from the 20th of May, and during the month of June, I reserve early clover and other grass at the rate of *one quarter of an acre for each head* of cattle soiled.

"For their support during the first half of October, I depended upon the *second growth* of the half acre cut over in May and June, and the *second growth* of oats and corn cut over in July.

"It now remains to be shown that the cost of raising, cutting, and distributing the food to the stock, is compensated by these savings above mentioned. Upon this point, my own experience has satisfied me that the *manure* alone is an ample compensation for *all* this expense; leaving the savings of land, of food, and of fencing-stuff, as clear gain from the system.

"A popular objection to this mode of keeping milch cows is, that want of exercise must affect injuriously the health of the animal. To this European writers, some of whom have kept, in this way, large herds, reply that they 'never had one sick, or one die, or one miscarry, in consequence of this mode of keeping.' After more than ten years'

pursuing of this practice, my experience justifies me in uniting my testimony to theirs on this point."

It is believed that in the West and Northwest, at least, *clover*, which runs its *roots deep* into the mellow ground, should enter more largely into these soiling rotations; it brings more of the fertilizing substances of the earth from *below*, by its long penetrating roots, than any of the others named; it absorbs faster the moisture of the air and the dews; it acknowledges more readily the manures furnished to it, and most kindly accepts the rankest sorts; while it is more easily and vigorously stimulated by plaster, or ashes, or lime, or other light top-dressings, and grows faster than almost any other vegetable; and, unlike most others, it does not have to be sown every season; then it does not appear to be affected or stinted so much by frequent cuttings; and, finally, is more pleasant for plowing under, when desired, than any other, its vast amount of large leaves, stems, and blossoms enabling it to consume from the air a larger and richer quantity of those fertilizers or nutriments, with which the atmosphere is bountifully charged, than many persons seem to be aware of; which, altogether, renders *clover* almost inestimable, not only for "soiling," but for its worth in farming generally, when fairly appreciated and employed; while very few things are better relished by all farm animals, if well and early cured, free from dust or "sun-burnt;" and farmers would find their account in making more general use of it; certainly in the newer States.

Buckwheat is also a good crop to soil with; for, if cut while young, it makes a very palatable food, and will quickly "sprout up" a little, and afford an excellent "green manure" for plowing under, on which to sow a crop of winter rye or wheat. This manuring with green crops turned under, is fast becoming deservedly popular where known.

Peas, also, would make a valuable addition to the above series of "soiling" plants in almost any region of country. They admit of being sown very early—it should be done broadcast, at the rate of two to three bushels per acre—as early as any of the spring crops, and then they grow quickly for green feed, and can be readily gathered into rows or bunches by either hand or horse rakes; then they contain, both the peas and haulm, a large quantity of nutriment, and are much relished by both cattle and hogs; and, when ripe, peas are among the very best feed for work-horses and fattening hogs, when ground or cracked. Then they come off early, leaving the ground in clean, handsome condition for a final crop of turnips or rutabagas. The same may be said of *beans*, as a soiling crop; though few animals, except sheep, will eat them when ripe, unless they are cooked, then they are much liked by different animals, and are exceedingly nutritious, particularly for sheep, poultry, and for fattening hogs.

These are the principal crops which can be used to advantage for "soiling" and rotation. But, doubtless, in different localities, various operators will find still other crops which may be found useful, possibly preferable, in this system, to some named above; and the more, if variety is secured, the better for the success of the operation.

From these considerations, with others which might be realized by a more extended practice, *soiling stock* will, unquestionably, prove to be

one of the most efficient, as it will be one of the most pleasing, measures for not only enlarging the profits of agriculture, but for MAINTAINING, as well as increasing, the PRODUCTIVE POWERS of the EARTH; and that the time for the realization of a consummation so desirable is no further distant than the time when the process shall receive that just attention which shall make it properly understood and adequately appreciated. Then the lion and the leopard, emblems of man's destructive passions, shall lie down with, that is, be in useful harmony with the domestic animals, emblems of the productive faculties of man; and a child, that is, innocence and truth, shall lead them all through the world of peace and prosperity.

AGRICULTURAL SCHOOLS OF PRUSSIA.

LEGATION OF THE UNITED STATES,
Berlin, May 15, 1859.

SIR: I send you herewith a communication from the minister of agriculture on the subject of the agricultural schools of Prussia.

As applications are constantly made to me for information concerning the agricultural schools of Germany, I hope you may find this communication worthy of publication. In a few days I hope to be able to forward you a list of seeds, &c., in order to have your opinion as to the proper articles to forward you this fall from this city.*

"The Prussian agricultural schools are, some of them, public, and others are private establishments, but all receive governmental support, and, as has been indicated, are generally under governmental control. In the first place there are *four* public AGRICULTURAL ACADEMIES, the purpose of which is to instruct *young farmers, who have already a preparatory knowledge,* in the physical sciences, and their bearing upon agriculture, and in agriculture itself, with its associated branches of industry. They are each provided with a chemical laboratory, a library, collections of natural history and natural philosophy, and a building for the practical purposes of husbandry, in connection with a larger or smaller quantity of land. This land is intended not only to afford instruction, but also in time to yield a harvest of benefit from the experiments carried on upon it, with the aid, where necessary, of the laboratory, and including the culture of new plants and varieties, the results derived from different manures, the comparison of different methods in the culture of crops and in the feeding of stock—all conducted with the double object of advancing scientific truth and of improving actual practice.

"The laboratory thus subserves an important purpose in the development of such experiments, while it is also essential for the chemical studies and analytical problems which form a part of the student's pursuits, and should therefore be located in a room adjoining the one occupied for chemical lectures. The other apparatus, particularly such instruments as the microscope, are also of use in conducting ex-

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* As this communication had already appeared in the Country Gentleman, (No. 1, vol. xiv., July 7, 1859,) it was deemed advisable to insert it as therein translated.

periments, and solving the resultant inquiries, and both teachers and pupils have the use of the library, the collections, models, &c.

"The oldest of the four institutions, to which this general outline applies, is that at *Eldena*, in New Citerior, Pomerania. It was established in 1834, upon an estate of the same name, belonging to the dotation of the University of Greifswalde, as a branch of the university. Originally its main object was the instruction in this department of national economy, of young men destined in after life to serve as public officers, and its discipline still continues such as it is supposed will best answer this particular end.

"As I understand the division of the 1,650 Prussian acres,* composing this estate, 1,200 are devoted to the practical agriculture of the farm, 314 are in meadow, 40 in pasture land, 19 in gardens and hops, 6 under water, (for ponds,) 17 in an experimental field, 2 or 3 in nursery, while the remaining 50 are rented. The soil is pretty fertile, and the ground quite even. A stock is kept of 25 horses, 21 oxen, 50 cows, 2 bulls, 20 young cattle, 884 sheep, and 71 swine. From 1,500 to 1,800 cwt. of malt, it is stated, are worked up annually in the great beer brewery; 350,000 bricks and tile for various purposes, and 300,000 draining tile are burnt in the kilns, and there is a small distillery—this last, however, merely for the instruction of the pupils. The faculty includes a director, (now Mr. BAUMSTARK,) who also teaches the economical and statistical branches; a teacher of agriculture, including the structure of vegetables, general farm management, and account keeping, and the history of agriculture; a teacher of chemistry, physics, the structure of the soil, and technology; and the administrator of the farm, who instructs in practical husbandry and in the associated arts, including particularly the care and breeding of sheep and cattle, the culture of meadows and of farm crops. There is also a teacher of botany, zoology, and the physiology of plants; an assistant teacher in veterinary science, the physiology of animals, and the breeding of horses; another in the cultivation and care of wood lands; a third in architecture; a fourth in mathematics and surveying; and a fifth on law as connected with agriculture. The number of students here last winter was 54, and a boarding-house was occupied by them in the village of Eldena.

"The second of the academies occupies nearly 4,100 acres on a public domain called *Proskau*, and includes two estates, one bearing this name, and the other called *Schimnitz*, in Upper Silesia—having, out of the above area, 466 acres in meadow, 33 in pasture, 25 now designed for an experimental field, and about 20 in nurseries and gardens, while some parts are let to private persons. The necessary buildings were provided in 1851 and 1852. The soil is argillaceous, with some sand and lime, and is rendered wet by springs, to obviate which some attempts have been made at drainage. The climate suffers from the vicinage of mountains. The stock kept includes 2,600 sheep, 20 hogs, 27 cows, and 138 other cattle, young and old, 51 horses, and 9 foals. Brewing and distilling are not done largely, but brickmaking is extensively carried on. The teachers include Mr. HEINRICH, the

*The Prussian acre, I think, is very nearly equivalent to our own.

director, and others similar to those at Eldena, and are 10 in number. There are here 77 students.

"Near Bonn is situated the academy of *Poppelsdorf*, the third on our list, and differing considerably from the other two, mainly in the smaller scale on which its farm operations are conducted. The estate, whose name it bears, belongs to the University of Bonn, and is leased to the ministry of agriculture, under whose supervision lectures were commenced in the fall of 1847. The farm contains 126 acres, of which 17 are employed in experiments, a botanical garden, and a vineyard. Its soil is of that most fertile and friable kind which characterizes the Valley of the Rhine, and it enjoys the climate of Southern Germany. Among its crops tobacco is cultivated, but the technical professions are not carried on, and the stock only numbers 25 cattle of all ages, and 3 horses, with apparently neither a sheep nor a hog. There are 70 students, and 6 teachers, including Mr. HARTSTEIN, the director, together with four assistant teachers. The courses of study appear very similar to those already described. I notice, however, that instruction is given in the care of silk-worms and bees, and in 'hunting and fishery.'

"Two miles from Königsberg, in the province of Prussia, there was opened in the fall of 1858, the fourth of the agricultural academies, which derives its name, like Proskau, from the public domain on which it is located—that of *Waldau*—a domain covering nearly 2,000 acres, including 430 of meadow, 335 of pasture, and 15 of garden land. The pasture is swampy and difficult to drain; the meadow, although good, is not yet protected from the inundations of the Pregel, on which river it lies; the soil is generally clayey, and the climate that of Northern Europe. The stock number 60 horses, young and old, the same number of cattle, 700 sheep, and 30 swine. Mr. SETTEGAST is director, and with four other teachers and one assistant, during the sessions of the past winter (1858–59) has had nearly 50 students, instructing them with especial reference to the husbandry of Northern Germany and the keeping of sheep.

"There are, moreover, two private agricultural academies receiving State support, but of quite limited means—one at *Mögelin*, in the province of Brandenburg, under the direction of the son of the celebrated THAER, and the other at *Regenwalde*, Pomerania, until the recent death of Dr. SPRENGEL, under his supervision.

"Then come what are termed 'private' agricultural schools, for the purpose of exercising the young peasants in the best ways of performing their labors, and to show them also WHY *one way is better than another*—to lead them to *think*. Consequently, the instruction given must be adapted to the faculties of its recipients, while the number of them varies according to the extent of the estate and the views of the owner. The products of their labor go to the benefit of the farm, and the crops are are either used in the institution or disposed of towards its support. The conditions on which students are received vary widely, like the branches in which they must be taught, with the different localities where the establishments are situated; usually the State contracts with the proprietor for the instruction of the student, during even as long a

period as ten years, and it also appoints one or more officials, as may be necessary, in the carrying on of the school.

"Of these schools I will not copy the list; it includes no less than 18, generally with from 6 to 18 students each; and situated four in the province of Prussia, three each in Posen and the Rhenish province, two each in Brandenburg, Saxony, and Westphalia, and one each in Pomerania and Silesia. One of those in Saxony, that at *Badersleben,* is in a district where the peasants are of a more wealthy class, and it has taken a character intermediate between the academies and the schools, having from 60 to 80 students, and over 1,300 acres of land. There is one in the Rhenish province which has 30 students, and another with 25. The aggregate of all these schools is over 300.

"In special branches of farming there is a school at *Treves* for the culture of meadows; one at *Eichsfeld,* on a small scale, for flaxdressers, and a well established garden school at Sansouci, near Potsdam, with 12 or 14 scholars.

"And to conclude with the lands devoted to experimental purposes, it has been already indicated that some experiments are constantly going on in connection with the four agricultural academies, under the general inspection of their directors, but having also a special manager, who is assisted by a chemist. In addition to these, at the large sheep establishment at *Frankenfelde,* in Brandenburg, where the principal object is to preserve a pure race, and where also young shepherds receive instruction, 40 acres are devoted to the purpose of particular experiments, while the whole 1,700 can indirectly be employed for larger trials. Some of the agricultural societies have given lands, erected laboratories, and appointed chemists, quite recently however, and the State is aiding their efforts with some money, but only for a few years, in order to test the results accomplished. Establishments of this kind have been instituted to the number of six, respectively by the societies of Lithuania, Pomerania, Silesia, Upper Lusatia, Brandenburg, and the Rhenish province. The investigations thus instituted are not regulated by any general system of coöperation, and their results appear from time to time in pamphlets and in the agricultural journals."

METEOROLOGY.

METEOROLOGY IN ITS CONNECTION WITH AGRICULTURE.

BY PROFESSOR JOSEPH HENRY, SECRETARY OF THE SMITHSONIAN INSTITUTION.

ATMOSPHERIC ELECTRICITY.

In this report, we intend to give a sketch of the general principles of atmospheric electricity, a branch of meteorology which has attracted in all ages more attention and has been regarded with more interest than perhaps any other.

The vast accumulation of electricity in the thunder cloud, and the energy exhibited in its mechanical, chemical, and physical effects, have impressed the popular mind with the idea of the great efficiency of this agent in producing atmospheric changes, and have led to views of its character not warranted by cautious induction. It is frequently considered sufficient in the explanation of an unusual phenomenon to refer it simply to electricity. References, however, of this kind, are by no means satisfactory, since the scientific explanation of a phenomenon consists in the logical reference of it to a general law; or, in clearly exhibiting the steps by which it can be deduced from an established principle. Electricity is subject to laws as definite and invariable as those which govern the mechanical motion of the planetary system. Indeed, there is a great similarity between them, and it will be seen in the discussion of electrical phenomena, that these are referable to forces similar to that of gravitation, and that the mathematical propositions which were demonstrated by Newton in regard to the latter, have been applied with admirable precision to represent those of the former.

In giving a general exposition of a subject of this kind, two plans may be adopted: either a series of facts may be stated, and from these a theory gradually developed by a careful induction, or we may begin with the general principles or laws which have been discovered, and from these deduce the facts in a series of logical consequences. The first method is called induction, the second deduction, and they are sometimes known by the more scholastic names of analysis and synthesis. The first method may perhaps be considered the more rigid, and, where a systematic treatise on a subject is intended, and ample space allowed for its full discussion, it might be preferred; but where the object is to give the greatest amount of information in the shortest time, to put the reader in possession of the means through

which, by his own reflection, he can deduce from a single principle, hundreds of phenomena, and declare, prior to experiment or observation what will take place under given conditions, the latter method will be the proper one to be adopted.

It is impossible, however, to state a principle of very general application without employing an hypothesis or an assumption which, though founded on strict analogy, may possibly not be absolutely true. We adopt such an hypothesis temporarily, not as expressing an actual entity, but as a provisional truth which may be modified or even abandoned when we find it no longer capable of expressing all the phenomena. All we assert positively in regard to such an hypothesis, is, that the phenomena to which it relates, and with which we are acquainted at the time, exhibit themselves as if it were true.

When an assumed hypothesis of this kind furnishes an exact expression of a large number of phenomena, and enables us beforehand to calculate the time and form of their occurrence, it is then called a theory. The two terms, however, hypothesis and theory, though in a strict scientific sense of very different signification, are often confounded and otherwise misapplied. *Theory*, in common language, is frequently used in contradistinction to *fact*, and sometimes employed to express unscientific and indefinite speculations. The cause of truth would be subserved if these terms were used in a more definite and less general sense; for example: if the term *speculation*, were restricted to those products of the imagination which may or may not have an existence in nature; the term *hypothesis*, to suppositions founded on analogy, and which serve to give more definite conceptions of laws; while the term *theory*, is reserved for generalizations which, although they are presented in the language of hypotheses, yet really furnish the exact expression of a large class of facts.

Hypotheses, well conceived and properly conditioned by strict analogy, not only enable us, as we have before stated, to embrace at one view a wider range of phenomena, but also assist us in passing from the known to the unknown. When rightly used they are the great instruments of discovery, giving definite direction as to the experiments or observations desirable in a particular investigation, and thus marking out the line of research to be pursued in our endeavors to enlarge the bounds of the science of our day. We think that the tendency of some minds, instead of being too speculative, is too positive; and while, on the one hand, there is too much of loose, indefinite, and consequently of useless speculation intruded upon science, on the other, an evil of an opposite kind, is frequently produced by attempting to express scientific generalizations of a complex character, without the aid of proper hypotheses; and to this cause we would principally ascribe the looseness of conception which frequently exists in well educated minds as to the connection and character of physical phenomena.

In accordance with the foregoing remarks, we shall make use of a theory to express the well-established principles of electrical action, and from this endeavor to deduce such conclusions as are in strict conformity with the observed phenomena. The intelligent reader who

attentively studies this theory, and exercises his reasoning faculties in drawing conclusions from it, will be able not only to explain many remarkable appearances which would otherwise be entirely isolated, but also to anticipate results, and to adopt means to prevent unpleasant occurrences or to ward off dangers.

The theory which we shall adopt is that invented by Franklin and extended and improved by Epinus and Cavendish. It is sometimes called the theory of one fluid, in contradistinction to the theory of Du Fay, of two fluids. The two theories, however, do not differ as much as at first sight might be supposed, and, when expressed mathematically, are identically the same.

No part of the writings of Franklin exhibits his sagacity and his power of scientific generalization in a more conspicuous light than his theory of electricity. The talents to discover isolated facts in any branch of science, although possessed by few, is comparatively inferior to that characteristic of mind which leads to the invention of an hypothesis, embracing in a few simple propositions, whole classes of complete phenomena.

THEORY OF ELECTRICITY.

According to the theory of Franklin, all the facts of ordinary electricity may be referred to the action of a subtle fluid, which perhaps fills all interplanetary space, and may be the medium of light and heat. In order that the phenomena of electricity may be represented by the mechanical actions of this fluid, it is necessary to suppose that it is endowed with certain properties and relations which may be expressed in the following series of postulates:

1st. The electric fluid consists of atoms so minute as to exist between the atoms of gross matter.

2d. The atoms of the fluid repel each other with a force varying inversely as the square of the distance; that is, when the distances are 1, 2, 3, 4, 5, &c., the forces are 1, $\frac{1}{4}$, $\frac{1}{9}$, $\frac{1}{16}$, $\frac{1}{25}$, &c.

3d. The atoms of the fluid attract the atoms of ordinary matter, with a force also varying inversely as the square of the distance.

4th. The atoms of gross matter devoid of electricity, tend to repel each other also with a force inversely as the square of the distance.

5th. The atoms of the fluid can move freely through certain bodies of gross matter, such as metals, water, &c., which are hence called conductors; and cannot move, or but very imperfectly, through other bodies, such as glass, baked wood, dry air, &c., which are called non-conductors.

6th. When each equal portion of space has the same amount of electricity, and each body in it has so much of the same fluid as to neutralize the attractions and repulsions, there are no indications of electrical action; and when the attractions and repulsions are thus neutralized, a body is said to be in its natural condition.

7th. The electrical equilibrium may be disturbed by friction, chemical action, chango of temperature, &c., or in other words by these

and other processes the fluid may be accumulated in one portion of space, and rendered deficient in another, and in this case electrical action is exhibited.

8th. The phenomena are of two classes, namely: statical or those of attraction and repulsion, in which the electricity is at rest, and dynamical, or those in which the redundant electricity of one portion of space is precipitated into that of another in which there is a deficiency.

9th. When the electrical equilibrium has been disturbed, and a body contains more than its share of electricity, it is said to be positively charged; and when it contains less, it is said to be negatively electrified.

The fourth proposition of this theory was added by Cavendish, in England, and by Epinus, in Germany, and was found to be necessary in order to render the several parts of the theory as given by Franklin logically consistent with each other. At first sight, it appears to be contrary to the general fact of the mutual attraction of all bodies, but it must be observed that when gross matter exhibits attraction it is in its normal condition, and that since the electrical force is infinitely more intense than that of gravitation, the latter may be a residual phenomenon of the former.

According to this theory, there are two kinds of matter in the universe—ethereal or electrical matter and gross, or, as it is frequently called by way of distinction, ponderable matter. The two, however, may have the same essence, and differ from each other only in the aggregation of the atoms of the latter; or, in other words, what we call gross matter, may be but a segregation or kind of crystallization of the ethereal matter in definite masses. Each kind of matter is, in itself, entirely inert, has no power of spontaneous change of place, and is equally subject to the laws of force and motion. A mass of ordinary ponderable matter, when once at rest, tends to continue at rest until put in motion by some extraneous force; so, also, the electrical fluid, when at rest, tends to remain at rest, and only moves in obedience to some impulse from without. From this theoretical inference, which is in accordance with all observation, it is an error to suppose that electricity is an ultimate power of nature, being in itself the cause of motion. Like the air, it is inert, and has no more tendency to spontaneous motion than this or any other fluid which may receive and transmit impulses, or which may have its equilibrium disturbed, and in the restoration of this equilibrium, give rise to motion, and produce mechanical effects.

Perhaps some currency is given to the idea that electricity is not subject to the mechanical laws which govern the actions of gross matter, because it is called an imponderable agent, and has thus, as it were, assigned to it a semi-spiritual character. The term imponderable, though convenient, is not properly applied, since it indicates a distinction which may possibly not exist. If electricity is, in reality, a fluid, it might exhibit weight, could it be so isolated and condensed as to become sensible to our balances. But whatever may be its nature, the phenomena which it exhibits can be referred to mechanical laws; and

it is in order that such a reference may be definitely made, that the hypothesis of a fluid is adopted. For a similar reason, the phenomena of light and radiant heat are referred to the vibrations of an ethereal medium, and it is in this way that the laws of motion which have been deduced from the study of gross matter, have been so successfully applied to them, and it is only so far as the facts of what are called the imponderable agents are brought under the category of mechanical laws, that they take the definite form which entitles them to the name of science.

THEORETICAL DEDUCTIONS AND ILLUSTRATIONS.

We do not intend to deduce from the theory we have presented, a complete system of electricity, but to give such deductions from it as will put the intelligent reader in possession of the principal known facts of atmospheric electricity, and particularly those which relate to thunder storms.

In the first place, if the ethereal medium, in its ordinary state of diffusion, fills all space, then it must be evident that when a body is charged with more than its natural share, a portion must be drawn from space around, and hence what one body gains other bodies in the vicinity must lose; or, in other words, there must always be as much negative excitement as positive. To exhibit this, as well as to illustrate some of the effects of the disturbance of the electrical equilibrium, provide two strips of glass an inch in width and twelve inches long, and on the end of one of these fasten, with beeswax or sealing-wax, a piece of woolen cloth about an inch and a half long; if the glass slips are warmed and rubbed together as shown in figure 1, and afterwards separated, they will exhibit signs of electricity. If the strip of glass of which the end is naked be brought near a pith-ball *C*, suspended by a single fiber of unconducting silk, along which the electricity which may be communicated to the ball cannot escape, the ball will be attracted, and immediately afterwards repelled. If, now, the end of the other glass having the woolen cloth on it, be brought near to the same ball, attraction will take place at a considerable distance. The one slip of glass will constantly attract, while the other will as constantly repel the ball. If, however, the two glasses be placed in contact, as they were when first rubbed, and thus presented to the ball, neither attraction nor repulsion will be exhibited.

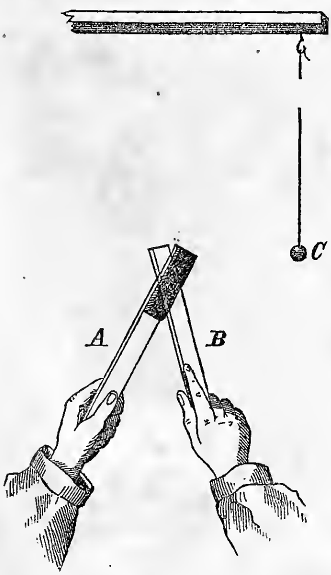


Fig. 1.

These results are in strict accordance with the theory we have adopted. By rubbing the glass and woolen cloth against each other,

the electrical equilibrium is disturbed—a portion of the natural electricity of the cloth is transferred to the glass; the latter receives a positive charge of electricity, while the woolen cloth loses a portion of its natural share of the fluid, and assumes the negative state; and since the slips of glass, as well as the surrounding air, are nonconductors, the redundancy of the one can not escape, nor the deficiency of the other be supplied, and therefore the charged condition of each will continue for a considerable time, particularly if the air be perfectly dry.

When the glass plate is made to touch the ball, a portion of electricity accumulated on the surface of the former is transferred to the latter, which has then more than its natural share; and, since atoms of free electricity repel atoms of free electricity, the ball will apparently be repelled from the glass; and also because there is an attraction between free electricity and unsaturated matter, the cloth, which is in this condition, will attract the same ball. When the two slips of glass are brought together, and presented as a whole, the attractions and repulsions may still be considered as existing, but since they are equal and opposed, they entirely neutralize each other, and no external effect is perceptible.

The neutralization of the two opposite forces in this experiment, affords an illustration of the condition of a body in its natural state. Although it contains a large amount of the fluid, no action is produced on other bodies in their natural condition, because the attractions and repulsions just balance each other.

For exhibiting the most important statical phenomena of electricity, and for verifying the deductions from the theory, we may employ a solid glass rod of about fifteen inches in length, and a rod of sealing-wax or of gum shellac of the same length. If these be well dried, held by one end and rubbed with a piece of woolen cloth at the other, electrical excitement will be produced. Instead of a solid glass rod, a tube may be employed, provided the interior be perfectly dry, and well corked to prevent the access of moisture. If the end of the tube or rod be rubbed, and afterwards brought into contact with a small ball of pith, or of any light conducting matter, suspended by a silk thread, the excitement will be communicated to the ball, and if the communication be from the glass rod the electricity will be that denominated positive; if from the rod of sealing-wax or shellac, it will be what is called negative. Since the phenomena exhibited by balls charged negatively and positively are very nearly the same, it is not of much consequence which we call the positive or which the negative, provided we always apply the same name to the same kind of excitement. In the early discovery of the two kinds of electrical excitement, that which was produced by rubbing glass with a woolen cloth was called *vitreous*, and that from the friction of the same substance on sealing-wax or gum shellac was denominated *resinous*, and these terms are still retained, particularly in foreign works on the subject.

The simplest instrument for exhibiting the attraction and repulsion of electrified bodies, and determining the intensity and character of the excitement, is the gold-leaf electrometer, which any person with a little patience and some mechanical skill may construct for himself. Different forms of this instrument are exhibited in Figures 2 and 8.

A brass wire, surmounted by a ball of the same metal, is passed through the cork of a small glass jar, or large-sized vial, from which the bottom has been removed and its place supplied by a disk of wood; and to the lower end of the wire, which may be slightly flattened, is attached, by means of any adhering substance, two narrow strips of gold leaf, so as to hang freely, and, when unexcited, parallel to each other without touching.

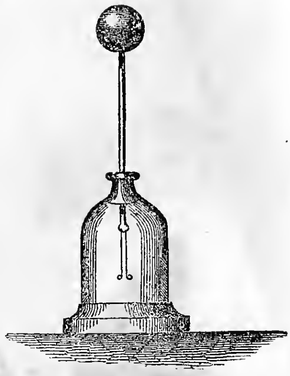


Fig. 2.

When we wish to ascertain if a body is electrified, or whether different parts of it are charged, for example, positively to the same degree, we bring in contact with the part to be examined, a small metallic ball suspended at the end of a very fine silk thread, (a fiber from a cocoon will serve for this purpose,) and afterwards bring the small ball, which may be called the carrier, in contact with the ball, or, as it is called, the knob of the electrometer. The electricity of the carrier will distribute itself, on account of the repulsion of its atoms, throughout the knob, the stem, and the leaves of the electrometer. The leaves being the only movable part, will diverge from each other, and will thus exhibit the electrical repulsion to the eye. We see from this experiment, as well as from that of the ball touched with the excited glass, that electricity may be transferred from one body to another, and that when it is applied to the end of an elongated metallic conductor it instantly diffuses itself over the whole mass. In the experiment we have just described, the body was supposed to have been *positively* electrified; but a similar effect would have been produced had it been negatively charged. In that case, a portion of the natural electricity of the carrying ball would have been drawn from it by the unsaturated matter of the electrified body, and the ball in turn, when brought in contact with the upper end of the electrometer, would draw from it a portion of its natural electricity—the deficiency extending to the leaves—which would therefore diverge, since, according to the theory, unsaturated matter repels unsaturated matter.

If we wish to ascertain whether a body is electrified negatively or positively, we transfer a portion of its charge to the electrometer by means of the carrying ball, and then, having rubbed a rod of glass with a piece of woolen cloth, we bring it near to the electrometer; if the leaves diverge further when the rod of glass is brought near, the original charge is of plus electricity; if, on the contrary, the leaves converge, we may consider the electricity as negative; or the same conclusion may be arrived at by rubbing a stick of sealing-wax with the woolen cloth, which, becoming negatively excited, will cause the leaves in the case of a positive charge to converge, and in that of a negative charge to diverge.

CONDUCTION AND INSULATION OF ELECTRICITY.

By means of a simple electrometer of the kind we have just described we may at once determine whether a body is a conductor or non-con-

ductor of electricity. If a slight charge be given to the electrometer, which may be effected by touching the knob with a rod which has been rubbed by woolen cloth, the charge will remain with but little diminution for several hours, provided the air is perfectly dry; while, if the air is moist, the charge is soon dissipated. These facts show that the former is a non-conductor, and the latter a partial conductor. Dry air would be a perfect insulator of electricity, provided it were motionless; the atoms, however, which impinge against a charged body become electrified with the same kind of excitement, and are, consequently, repelled off, their place being supplied with others, and so on until the charge is gradually diminished and finally dissipated.

If, when the electrometer is charged in dry air, we touch the knob with a glass rod, the leaves will be but little affected; but, if we breathe on the surface of the rod, the glass will become a partial conductor and the leaves will slowly converge. If the ball be touched with one end of a metallic wire, the electricity will instantly be conducted off. If we make a similar experiment with a piece of dry wood, the charge will be gradually dissipated, a fact which indicates that wood is a partial conductor. By increasing the length of an imperfect conductor we shall find that the time of drawing off the charge is increased, and in this way it may be shown that there are very few bodies which are perfect conductors or non-conductors; that every body offers some resistance to the passage of an electrical current, provided we increase the length sufficiently to make it perceptible. By experimenting on various bodies in the way we have described, we may form an approximate table of the degrees in which different substances are conductors or non-conductors of electricity. The human body is a very perfect conductor of ordinary electricity, since if we touch the knob of the electrometer with the finger, the leaves instantly collapse, provided we are standing at the time on the ground. If, however, we place a non-conductor, for example, a cake of beeswax, under the feet, the whole of the charge will probably not be withdrawn but shared with the body, and the leaves will only partially converge. It may also be shown by the same instrument that in order to produce electrical excitement by friction, it is only necessary that two dissimilar substances be rubbed together, one at least of which must be a partial conductor. For example, if, while a person is standing on a cake of beeswax he place one finger on the knob of an electrometer and another person strike him on the back with a silk handkerchief, the leaves will instantly diverge, showing that the whole body has received a charge of electricity, which is prevented from escaping into the floor by the interposed non-conducting beeswax.

After the introduction of furnaces for heating rooms by warm air, the public were surprised at exhibitions of electrical excitement which previously had not been generally observed. If our shoes be very dry, and we move over the surface of a carpet, with a shuffling motion, on a very cold day, particularly in a room heated by a furnace, the friction will charge the body to such a degree that a spark may be drawn from the finger, and under favorable circumstances a jet of gas from a burner may be ignited. There is nothing new or wonderful in this experiment; it is simply an exhibition of the production of electricity

by friction, which only requires the carpet, the shoes, and the air to be dry, conditions most perfectly fulfilled on a day in which the moisture of the air has been precipitated by external cold and its dryness increased by its passage through the flues of the furnace. In the ordinary state of the atmosphere, the electricity, which is evolved by friction, is dissipated as rapidly as it is developed, but in very cold weather the non-conducting or insulating power of the air is so much increased that the electricity, which is excited by the almost constant rubbing of bodies on each other, is rendered perceptible. Every person is familiar with the fact, that, on removing clothes, or shaking garments in dry weather, the electricity evolved by the rubbing exhibits itself in sparks and flashes of light. The popular idea in regard to this is, that the atmosphere, at such times, contains more electricity than at others, but these appearances are not due to the variation of the electricity in the atmosphere, but simply to the less amount of vapor which is present. When the clothes are rubbed together one part becomes positive and the other negative, and in dry air the excitement increases to such an intensity that the restoration of the equilibrium takes place by a visible spark, but in the case of moist air the equilibrium is silently restored as soon as it is disturbed, and no excitation is perceptible.

Similar effects are observed on the dry plains of the western part of our continent; in rubbing the horses or mules, sparks of electricity may be drawn from every part of the body of the animal. Persons in delicate health, whose perspiration is feebly exhaled, sometimes exhibit electrical excitement in a degree sufficient to surprise those who are not familiar with the phenomena. But these exhibitions have no connection with animal electricity, and are merely simple illustrations of the electricity developed by friction in an atmosphere too dry to permit the usual immediate and silent restoration of the electrical equilibrium.

DISTRIBUTION OF ELECTRICITY.

The mutual repulsion of the atoms of electricity, varying inversely as the square of the distance, gives rise to the distribution of the fluid in regular geometrical arrangements, the form of which may be calculated with mathematical precision. As one of the simplest cases of distribution, suppose a conductor of the form of a cylinder, with hemispherical ends—for example, one of wood, covered with tin foil—to be suspended horizontally in dry air with silk threads, and, thus insulated, to be slightly electrified by touching the middle of it with a charged body; the atoms of the fluid, by their mutual repulsion, will separate as far as possible from each other, and be found at the two extremities. If the conductor were not surrounded with a non-conducting fluid, like the air, they would be driven off by the same repulsion into space, and thus indefinitely separated.

This inference, from the theory, can readily be proved to be in accordance with the actual condition of the excitement, by bringing into contact with the middle of the length of the conductor a small carrier ball, and afterwards applying it to the knob of the electrometer. If the charge given to the conductor be small, scarcely any electricity will be found at the middle; if, however, the carrier be brought into contact with either end of the conductor, it will receive a charge of such

intensity as to cause the leaves to diverge widely from each other. If a charge of electricity be imparted to the center of a conductor in the form of a thin circular disc the fluid will be found, by a similar examination, in the greatest intensity, at the outer rim.

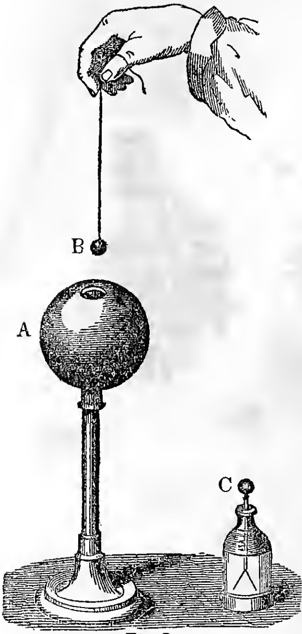


Fig. 3.

If we electrify a solid globe of metal, the excitement will be confined to an indefinitely thin stratum just at the surface of the conductor; for if the electricity be imparted to the center of the globe along a wire through a glass tube, the atoms will evidently separate from each other as far as possible, on account of their mutual repulsion, and would continue to diverge even beyond the surface, were it not they are stopped by the non-conducting air which surrounds and insulates the globe. That this inference is true may be shown by an arrangement which is exhibited in Fig. 3, in which A represents a hollow metallic globe, insulated on a glass pillar and charged with electricity. If the carrier ball B be let down into the interior of the globe, so as to touch the inner surface and then withdrawn without touching the side of the hole it will be found entirely free from electricity. If, however, it be made to touch the outside of the globe it will carry off with it a charge which will cause the leaves of the electrometer C to diverge in proportion to the original quantity imparted to the sphere. A similar effect will be exhibited if the ball be lowered into an insulated cylinder of gauze A, Fig. 4, which has been charged with electricity. Not the least sign of excitement will be found on the inside, while a spark may, perhaps, be drawn from the exterior. The same result is produced, as we shall see, whether the globe be charged negatively or positively.

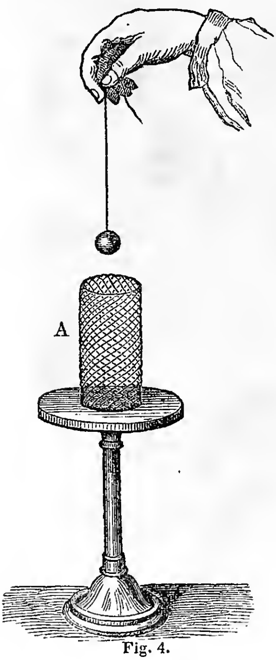


Fig. 4.

Newton has demonstrated the following propositions relative to the action of gravitation, which are equally applicable to electrical attraction and repulsion, or any other action which varies as the square of the distance:

1. A particle of matter placed outside of a hollow sphere of attracting or repelling matter of uniform thickness, is acted upon as if all the matter were at the center of the sphere.

2. A particle of matter (or of free electricity) placed at any point within a hollow sphere of uniform attracting or repelling matter, will be acted upon in every direction by an equal force, and will consequently be at rest.

The form of the demonstration of the first of these propositions may be easily understood by a reference to Figure 5. In this *a* represents a particle of matter or of electricity attracted or repelled by the hollow sphere of which the center is *C*. Let the two lines *a d* and *a e* represent the projection of a pyramid having its apex in *a*, and its base in *d e*, then it will be evident that the attraction of the three sections of the cone, one through the center, another coinciding with the upper part of the spherical shell, and the third with the lower part included within *d e*, will be equal. For, although the lower section is at a greater distance from *a* than the upper, yet its greater size just compensates for the greater distance, the surface increasing, as in the case of light, as the square of the distance, while the attraction and repulsion diminish in the same ratio. For the same reason, each of the two portions of the spherical shell are equal in action to a plate of equal thickness through the center, included within the cone; and hence, the two together will be equal to a plate of double thickness at the center.

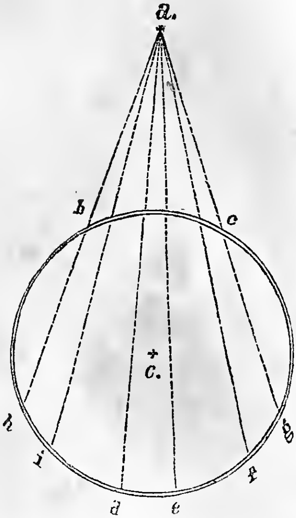


Fig. 5.

If, in the same way, we suppose the whole spherical shell included in a series of pyramids or cones, having as a common apex the point *a*, and consider this series of cones made up of equal pairs, the two members of which are on each side of the line through the center as *a h i*, and *a f g*, then it will be clear that the resultant action of each of these pairs of cones will be in a line through the center, and all the action of the sphere made up of such cones the same as if it were at this point.

That a point at the center of a hollow sphere would be equally acted upon, in all directions, is evident; but that the same should be the case when the point, for example, is at *a*, Fig. 6, is not quite so clear. It may, however, be rendered evident by considering the actions of the opposite bases of the two cones *a b c* and *a d e*, or *a f g* and *a h i*, which, for a reason similar to that given in the preceding proposition, are respectively equal to each other; and as we may consider the whole interior surface of the spherical shell made up of the opposite bases of a series of pairs of similar cones, it is clear that the particle at *a* will be equally attracted or repelled on all sides, or, in other words, will be apparently unaffected by the action of the excitement which may exist at the surface

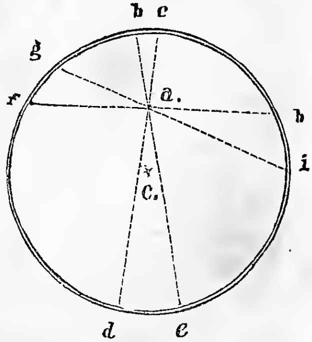


Fig. 6.

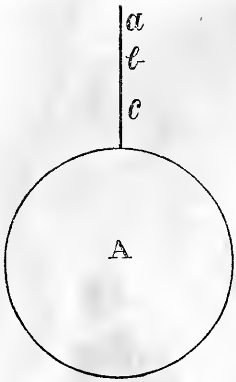


Fig. 7.

From the first of these propositions, it is easy to deduce the effect of a point in discharging the electricity from a globe. For if A, Fig. 7, be the center of a charged sphere, from which the slender-pointed conductor *a b c* projects, then will the action on the point *a* of all the electricity of the sphere be the same as if it were at the center; and if we suppose, for example, that the sphere is charged with positive electricity, then will the atoms of electricity of the point *a* be repelled by all the atoms of the fluid of the globe, as if they were concentrated at A, and also the atoms of the fluid at the point *b*, below *a*, will be repelled by all the atoms of the electricity of the globe, as if they were concentrated at the same point, and so on with the atoms at *c*, &c.; therefore, the atoms at the point *a* will not only be directly repelled outward by the atoms of the fluid in the sphere, but they will also be pressed outward by the repulsion exerted on each of the atoms below, so that the whole force exerted to drive off the fluid from the point *a* will be in some relation to the number of atoms in the perpendicular column below this point; and hence the tendency which must exist in a point projecting from a charged surface to rupture the air and to escape, and for a similar reason, when the globe is charged negatively, to draw in electricity from surrounding bodies.

From the second proposition, we can readily deduce the fact of the distribution of the electricity at the surface; for if we communicate to the interior of a globe, a quantity of electricity just sufficient to arrange itself in a stratum of the thickness of a single particle, it will so arrange itself, on account of the mutual repulsion of the atoms, but if an additional quantity is thrown into the interior, it might not appear evident that this would also come to the surface, since the repulsion of the atoms already at the surface, as it would seem at first sight, would drive the additional atoms back towards the center; but, from the second proposition, the inner atoms are not affected by the outer, and, consequently, they would separate from each other by their mutual repulsion, as if the latter did not exist, and arrange themselves at the surface. That this should take place, is not difficult to understand, when the sphere is charged with redundant electricity; but when a deficiency exists, the explanation has not been thought as easy. If, however, we suppose a quantity of the natural electricity drawn from the interior of a solid globe, then the unsaturated matter in the center of the globe will act as a sphere, and draw into itself the electricity from around, and thus produce a hollow sphere of attracting matter, which will draw again into itself from around the natural electricity, and in this way, it must be evident, the deficiency will finally come to exist at the surface.

These propositions, which, as we shall see, are of great importance in the study of the theory of atmospheric electricity, can be readily

demonstrated experimentally. If we coat a large hollow glass globe with tin foil, and insert through an opening into it a delicate electrometer, consisting of two slips of gold leaf suspended parallel to each other, and a small piece of the covering of tin foil being removed at two points on opposite sides to observe any effects produced within, not the slightest divergence will be seen in the gold leaves, when the globe outside is intensely charged with electricity. The same result will be obtained when a slip of gold leaf is suspended in the interior and electrified, either positively or negatively. It does not follow, from these experiments, that the electricity on the outside does not act on that of the inside. On the contrary, we must infer from the theory that every atom of electricity at the surface acts repulsively on every atom of electricity in the gold leaf; but these actions are equal in all directions, and therefore neutralize each other.

The second proposition may be demonstrated by means of a charged ball and the hollow globe, Fig. 3. If the charged ball, suspended by a silk thread, be placed at about eighteen inches above a gold-leaf electrometer, and the divergence noted, when the ball is removed and its place occupied by the center of the globe to which the electricity of the ball has been imparted, the divergence will be the same as before; or, in other words, the action on the electrometer will be the same when a given quantity of electricity is concentrated on a ball at the center of a sphere, or diffused throughout the surface of the same body. This experiment may be varied, with more striking results, by placing the hollow globe at a given distance from the electrometer, and then letting down into its interior until it reaches the center a charged ball, the leaves will be seen to diverge to a definite degree; if the ball be now made to strike the interior surface of the globe, by moving the suspending thread of silk, the whole of the charge will pass to the surface of the latter, but the leaves will exhibit the same amount of divergence as before the transfer. The electricity which is distributed throughout the surface of the globe produces precisely the same effect as it did when confined to the ball at the center.

The mathematical problem to be solved, for the purpose of calculating the distribution of a given charge of electricity in a body of any form, is to proportion the amount of the fluid in each part of the surface, so that the resultant action on the interior of a body will be completely neutralized. This problem, which is simple for the sphere, becomes too complex, even for the highest powers of mathematics, for bodies of less regular forms than those generated by the revolution of simple curves.

ELECTRICAL INDUCTION.

The attraction and repulsion of electricity, like those of magnetism, act at great distances, and produce phenomena which it is necessary clearly to understand, in order properly to comprehend the explanation of many of the facts connected with atmospheric electricity.

For the exhibition of these phenomena, which are classified under the name of inductive effects, we may make use of the arrangement

represented in Fig. 8, in which A is a metallic globe suspended in free air by a fine silk thread, and is thus insulated. O is a long cylindrical metallic conductor, supported by a rod of shellac or sealing-wax *d*, on a stand *e*, having a glass stem.

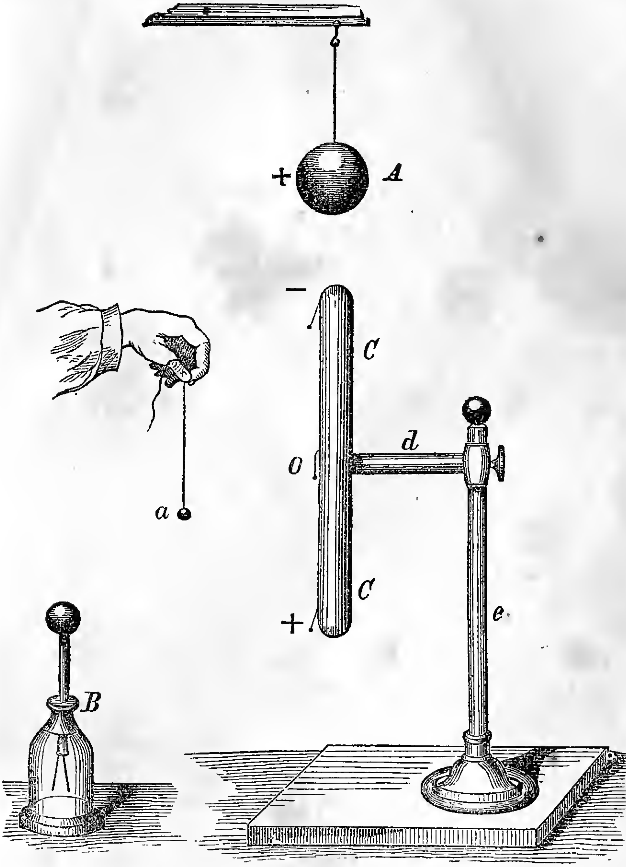


Fig. 8.

Now, each of these metallic bodies contains its natural share of electricity, and, as long as this continues to be the same, no electrical effects are exhibited; for although the natural electricity of A will repel the electricity of O, yet the matter of A will attract it with an equal force, and hence there will be no perceptible effect. Let us, however, suppose that there be imparted to the globe A, a redundant quantity of electricity, then the equilibrium will be disturbed in the conductor O, the repulsion of the redundant fluid will be greater than the attraction of the unsaturated matter, and hence a portion of the natural electricity of O will be driven down to its lower end, and consequently the upper end will become negatively electrified, while the lower is positive. It must be evident, therefore, that, between the two extremes, there will be a point near the middle which will be in its ordinary condition.

These inferences may readily be shown to be true by observing three movable pith balls suspended by linen threads, one near the top, another at the middle, and the third at the lower end. Those at the two extremities will diverge, exhibiting excitement at the two ends, while the one at the middle will remain unmoved, indicating that this point is in a natural condition. To be assured that the upper end is negatively electrified, and the lower positively, it is only necessary to rub a stick of sealing-wax with woolen cloth, and to bring it in succession near the two balls; the upper one will be repelled and the lower one attracted; or we may arrive at the same results by touching in succes-

sion the two extremities and the middle of the conductor with the small carrier ball a, and applying it to the knob of the electrometer B.

If the conductor O be removed laterally to a distance from under the charged globe, the excitement will disappear, the atoms of natural electricity, by their mutual repulsion at the lower end, and attraction for unsaturated matter at the upper end of the conductor, will cause them to distribute themselves uniformly, and to assume the natural condition. In this experiment the fact is illustrated that all bodies are naturally charged with electricity, which exhibits itself when the equilibrium is disturbed by the action of some extraneous force. If the conductor O is restored to its former position, the excitement will be renewed, provided the globe A has lost none of its charge, and the two pith balls will diverge as before. If the charge of electricity in the insulated globe be increased, the repulsive action, or induction, as it is called, will also be increased; another portion of electricity will be impelled down into the lower end, increasing the repulsive action at that point, and also the amount of attraction at the upper end. The middle of the conductor, however, will still remain in a condition of neutrality. Again, if while the charge in the globe A remains the same, the space between it and the upper end of the conductor is diminished, a greater excitement will be exhibited by the increased divergence of the balls at the two extremities; for, since the force increases with a diminution of distance, an additional quantity of the natural electricity of the upper end will be driven down into the lower end, and an equal amount of unsaturated matter will be left at the upper end.

We may still further vary the experiment by lengthening the conductor O, the charge of the globe and its distance from the upper end remaining the same, and for this purpose the conductor may be made to draw out like the tube of a telescope. We shall find that the greater the length, the greater will be the intensity of the effect at each end. To understand this we have only to recollect that the atoms of electricity constantly repel each other, and that, in the case of a short conductor, but little, comparatively, can be driven from the upper end, because the self-repulsion of the electricity of the lower end and the attraction of the unsaturated matter of the upper end, both conspire to restore the distribution, but when we give a greater length to the conductor for the free electricity of the lower part to expand into, and thereby lessen the intensity of the repulsion and also remove the free electricity further from the center of attraction of the redundant matter, the tendency to restore the normal condition is much lessened, and a new quantity will be repelled into the lower end from the upper, and thus produce at that end a greater intensity of excitement. If we increase indefinitely the length of the conductor, or, what amounts to the same thing, if we connect the lower end of it by means of a metallic wire or other conductor with the earth, or elongate it till it touches the earth, then we shall have the maximum of effect. The neutral point will descend to the earth, while the conductor, throughout its entire length, will be charged negatively.

The effects which we have described are those which would take place if we supposed the electricity in the globe suffered no change in

its distribution on account of the induction; but this cannot be the case, since, in the action of one body on another, an equal reaction must be produced, hence the unsaturated matter in O will react on the free electricity in the globe, and draw down into its lower side a portion of that which before existed in the upper side, and thus render the lower side more intensely redundant than before. This additional quantity of free electricity in the lower side, will tend to increase the amount of unsaturated matter in the upper part of the conductor. The maximum effect will be produced, as we have before stated, when the lower end of the conductor is brought in contact with the earth, which may be considered as a conductor of infinite capacity. In this condition the self-repulsion of the atoms of the fluid in the lower part of the globe, and the attraction of the unsaturated matter in the upper end of the conductor, may become so great as to cause a rupture of the intervening air and a transfer of the redundant electricity in the form of a spark from the upper to the lower body.

If, instead of the metallic conductor, we substitute a rod of shellac or glass of the same length and diameter, under the same conditions, no spark, or but a very feeble one, will be produced. The natural electricity cannot be driven down on account of the nonconducting character of the material, and while it remains at the top it repels the free electricity of the globe as much as the matter of the globe attracts it. For a similar reason, if a small brass ball be placed on the top of a rod of glass and presented to the globe, but a feeble spark will be elicited; the inductive influence will act in this case under unfavorable conditions, a portion of the natural electricity, it is true, will be driven down into the lower surface of the ball, and an equal amount of unsaturated matter will exist at the upper surface; but the attractions and repulsions will be so nearly at the same distance that comparatively but a feeble effect will be produced. An attentive consideration of these facts is essential to a knowledge of atmospheric electricity, and necessary to understand and guard against the effects of the destructive discharges from the thunder cloud.

The inductive action we have described takes place, at a distance, through an intervening stratum of air, but the same effect is produced, and with nearly the same intensity, when the intervening space is occupied with glass, or any other nonconducting substance. If a disk of wood, which is a partial conductor, is interposed, the effect will be slightly modified, because an inductive action will take place in the substance of this, which will tend to increase the effect in the conductor O, below.

As an illustration of the inductive influence of free electricity at a distance on the natural electricity of a conductor, we shall direct the attention of the reader to an arrangement exhibited in Figure 9, which is that of an experiment made by the author of this paper in Princeton, in 1845. Two circular disks of wood, *a* and *b*, each of about 4 feet in diameter, were entirely covered with tin foil; one was insulated in connection with a large conductor of an electrical machine, in the upper story of a building, the other was supported on a glass foot in the lowest story, at the distance of about 20 feet below, with two floors and ceilings intervening. The upper disk being charged by

the machine, the lower one was touched with the finger, so as to suffer the induced electricity to escape into the ground. If, when in this condition, the knuckle was held near the lower disk and the upper one suddenly discharged by a spark received on a ball attached to the end of a wire connected with the earth, a spark was seen to pass between the knuckle and the lower disk, a similar effect was produced when the upper plate was suddenly charged by powerful sparks from the machine, though the intensity in this case was somewhat less.

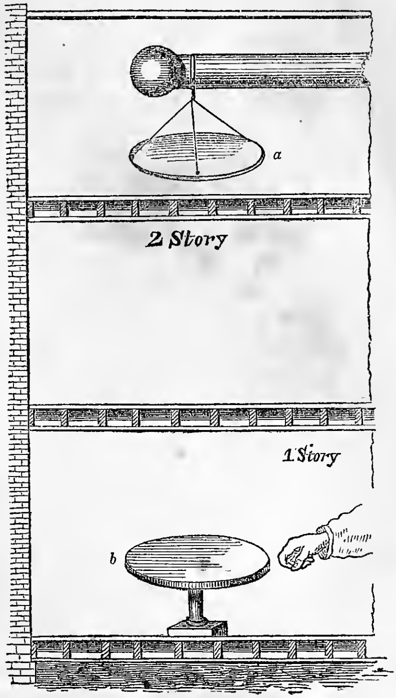


Fig. 9.

In this experiment, the upper disk may represent a charged thunder-cloud, and the lower one the ground, or any conducting body within a house. While the charged cloud is passing over the building, all conducting bodies in it, by this inductive action at a distance, have their natural electrical equilibrium disturbed; the upper part of each body becoming negatively electrified, and the lower part positively; and if the cloud continue in this position for a few minutes, the free electricity of the lower part of the conductor will be gradually driven into the earth, through the imperfect insulation of the floor. If, in this case, the lower part of the cloud is suddenly discharged, sparks of electricity may be perceived, and perhaps shocks experienced, by the inmates of the dwelling, produced by the sudden restoration of the equilibrium, due to the removal of the repulsive force of the cloud on the natural electricity of the bodies below.

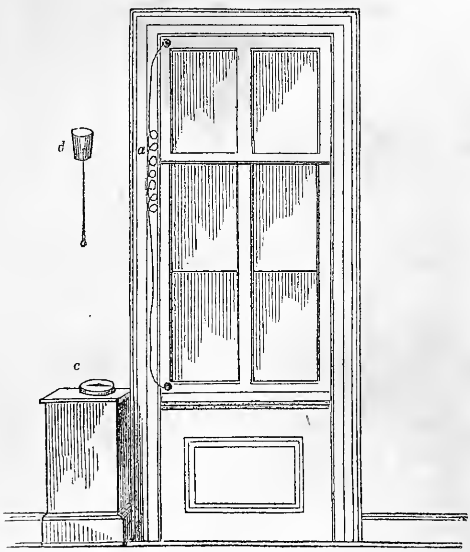


Fig. 10.

The inductive action of the electrical discharge at a distance is still more surprisingly exhibited, by an arrangement shown in Figure 10, which

the writer of this article adopted during his electrical investigations at Princeton.

The roof of the house which he occupied in the college campus was covered with tinned iron, and this covering was therefore in the condition of an insulated plate, on account of the imperfect conduction of the wood and brick-work which intervened between it and the ground. To one of the lower edges of this covering was soldered a copper wire, which was continued downwards to the first story and passed through a gimlet-hole in the window-frame into the interior of the author's study, and was then passed out of the lower side of the same window, and thence into a well, in which it terminated in a metallic plate below the surface of the water. Within the study the wire was cut in two, and the two ends thus formed were joined by a spiral of finer wire *a* covered with silk thread. Into the axis of this spiral a large-sized sewing-needle *d* was inserted, the point having been previously attached to a cork, which served as a handle for removing it. With this arrangement, the needle was found to become magnetic whenever a flash of lightning was perceived, though it might be at the distance of several miles. The intensity of magnetism and the direction of the current were ascertained by presenting the end of the needle to a small compass represented by *c*. In several instances the inductive action took place at such a distance that, after seeing the flash, the needle was removed, its magnetic condition observed, and another needle put in its place, before the noise of the thunder reached the ear. In this experiment, the inductive action of the electrical discharge in the heavens was exerted on the natural electricity of a surface of about 1,600 square feet, and a considerable portion of this passed down through the wire into the well. The arrangement served to indicate an action which would otherwise be too feeble to produce sensible effects.

It must be observed that the effect here described was not produced by the actual transfer of any electricity from the cloud, but was simply the result of induction at a distance, and would probably have been nearly the same had the intervening space been filled with glass or any other solid non-conducting substance. We say probably, very nearly the same, because Mr. Faraday has shown that the inductive effect at a distance is modified by a change in the intervening medium.

It is also proper to mention, in this place, although we cannot stop to give the full explanation of the means by which the result was obtained, that the electricity along the wire was not that due to a single discharge into the well, but to a series of oscillations up and down in alternate directions, until the equilibrium was restored.

ELECTRICITY IN MOTION.

The phenomena we have thus far described relate principally to electricity at rest. Those which relate to ordinary or frictional electricity in motion have not been so minutely investigated as the other class, and present much more difficulty in ascertaining the laws to which they are subjected. The discharge of electricity from the clouds, or from an ordinary electrical machine, is so instantaneous that we are

principally confined in our investigations to the effects which remain along its path after its transfer.

The electricity, however, which is developed by chemical action in a galvanic battery, is of sufficient quantity to produce a continuous stream, or at least a series of impulses in such rapid succession that they may be considered continuous. By employing electricity of this kind, it has been supposed that we can study the fluid while it is actually in motion, and from the results deduce inferences as to the mode in which some of the effects are produced in the discharge of frictional electricity. The two classes of phenomena, however, though referable to the same cause, are, in many respects, so different in character that considerable caution is required in regard to inferences from analogy. The phenomena of ordinary electricity are characterized by an intensity of action which indicates a repulsive force between the atoms of the hypothetical fluid, which, in some way is, at least, partially neutralized in the case of galvanism.

Ordinary electricity in a state of equilibrium appears to produce but a very feeble effect upon bodies in which it is accumulated. However great may be the quantity present, no perceptible effect is perceived in the pulse when a person is insulated on a glass stool, and charged either positively or negatively, so long as the electricity remains at rest. If, however, it is drawn from him in the form of a spark, then a disagreeable pricking sensation is experienced at the point of rupture. Dr. Faraday constructed a small metallic house or room, which he suspended by silk ropes in mid air, and charged it so strongly that long sparks could be drawn from the outside, yet not the least effect was perceived by the persons within; even when the air of the interior of the house was strongly electrified, the excitement was only perceptible on the outside.

It is fully established by the most satisfactory experiments that, in all cases in which a discharge of electricity takes place by breaking through a stratum of non-conducting substance like air, there is an actual transfer of matter each way between the two ends or sides of the opening in the conductor along the path which the spark traverses. If an opening be made in a rod, and each end terminated by a brass ball, one of which is covered with gold leaf, and the other with silver, a transfer in opposite directions of these two metals will be observed. A similar effect is produced in the discharge of lightning from the clouds, and there are several well authenticated cases on record, in which a picture as it were of one body has been impressed on another between which the electrical discharge took place.

Another effect produced by the discharge which has an important bearing upon the explanation of some of the mechanical results of electricity, is a sudden and violent repulsive energy given to the atoms of air and other substances through which it passes, and which causes them to separate with an explosive violence.

This may be shown by transmitting a discharge from an electrical battery between two brass balls projecting into the inside of a glass bulb, to the lower side of which is joined an air-tight tube containing a small quantity of water, and opening at the end into a cup of water, the arrangement with the exception of the balls being similar to that

of an air thermometer. The moment the discharge takes place, the water will be driven down the tube, exhibiting a great enlargement of the volume of air in the bulb. This experiment was communicated by Mr. Kinnersley, of Philadelphia, to Dr. Franklin. The effect was attributed at first to heat produced by the discharge of electricity through the air in the bulb, but although there is heat evolved in this case, as is proved by the fact that if a number of sparks be passed in succession, the water does not return to its first altitude, and thus indicates an increase of temperature, yet the principal cause is evidently due to the sudden repulsive energy given to the air at the moment of the passage of the discharge, as may readily be shown by inclosing a thermometer within the bulb. The increase of temperature which this indicates, will be far too small to account for the great and sudden expansion produced. A similar exhibition of force is exhibited when a strong discharge of electricity is passed through a vessel like the one we have described, filled with water. In this arrangement a thick glass bulb may be broken with violence into pieces.

The mechanical effects produced by lightning must be attributed principally to this cause. When a powerful discharge from a cloud passes through a confined space filled with air, and surrounded by partial non-conductors, a tremendous energy is exerted. In the case of a house examined by the writer of this article, the discharge fell upon the top of a chimney at the west end of the building and passing through a stovepipe hole, traversed the space under the rafters called the cockloft, to the chimney at the east end, and thence down to the ground; the force exerted was sufficiently great to lift up the whole roof from the top of the walls on which it rested. In like manner, when the discharge takes place along the upright timbers of a house, the clapboards are frequently blown off outwards, and the plaster inwards, as if by the explosion of gunpowder.

We must ascribe to a similar action the splintering of trees by lightning. At the moment of the passage of the discharge, the sap or moisture is suddenly endowed with a repulsive energy which resembles in its effects the action of an explosive compound, separating the fibers longitudinally, and projecting parts of the body of the tree to a distance. When a tree is struck by lightning the greatest effect is usually produced on the main stem just below the branches. A portion of the discharge appears to be received on each twig, leaf, and branch, and the whole concentrated by converging towards the trunk. The repulsion imparted to the atoms of a conductor is in some cases sufficiently great to dissipate at once in vapor, fine metallic wires, and this so instantaneously that the silk covering by which they are surrounded for telegraphic purposes is not burned.

The repulsive energy is not alone exerted laterally, but, perhaps, in a greater degree in the line of direction of the conductor, tending to separate it as it were, by transverse sections. Hence, when electricity passes through a wall into the interior of a house, a pyramidal mass of plaster is thrown out; a similar effect is frequently produced when the discharge takes place between the cloud and the level earth; a large conical or pyramidal hole is formed, from which the earth is thrown out as if by the explosion of a quantity of powder beneath the

surface. Such excavations are supposed by some to indicate a discharge of electricity from the earth to the cloud, but no conclusion of this kind can, with certainty, be drawn from the phenomena. It simply indicates an intense repulsive energy exerted between the atoms of matter in the line of the discharge. It sometimes happens, when an old tree, which, perhaps, has been moistened by the rain, is struck by lightning, instead of being rent laterally, it is broken off transversely, the upper part being projected vertically upward. This effect, however, is not usually produced, since the force exerted by the tree to resist transverse breaking is generally much greater than that to prevent lateral tearing apart.

In the passage of electricity from a charged conductor, or from a cloud to the earth, it always follows the line of least resistance, and by an antecedent induction, determines the course it is to pursue. This is strikingly exhibited by an experiment devised by Sir W. S. Harris. A number of separate pieces of gold leaf are attached to a sheet of paper. If a discharge sufficiently strong to dissipate the gold and blacken the paper be passed through them, its course will be shown by the blackened parts; and it is especially worthy of remark, that not only are the pieces out of the line of least resistance untouched, but even portions of other pieces are left unchanged from the same cause. Now, these separate pieces of gold leaf may be taken to represent detached conductors fortuitously placed in the construction of a building.

The apparently fitful course of a discharge in its passage through a building frequently excites surprise, leaping, as the electricity does, from one conductor to another, and sometimes descending to the earth in several streams; but that the discharge should leap from one conductor to another, through a considerable intervening space of air, is not surprising, since its original intensity was sufficient to enable it to break through a stratum of the atmosphere of perhaps a mile in thickness before it reached the house.

Whenever electricity passes through an interrupted conductor so as to exhibit the appearance of light, a great increase of intensity is always manifested at the point of disruption, as if the charge halted here for a moment until a sufficient quantity of the fluid could accumulate to force its passage through the obstacle. An illustration of this action is presented in the fact, that at the point where the lightning leaves a conductor, and also where it is received by another conductor, signs of fusion or of more intense action are always exhibited. An effect of lightning described by Professor Olmsted, at a meeting of the American Association, in New Haven, may be explained on this principle: A row of five or six milk pans, placed in the open air on a bench, was struck by a discharge from a cloud. The electricity passed through the whole series, making two holes in each at opposite extremities of the diameter, or at the places where the electricity may be supposed to have entered and gone out.

There is another circumstance connected with the discharge of electricity having an important bearing on the construction of lightning-rods, which may be mentioned in this place. When the repulsion of the atoms of electricity in a conductor or in a cloud, and the attraction

of the unsaturated matter below, become so intense as to cause a rupture in the air, the electricity of the cloud is precipitated upon the conductor, and not only restores the natural quantity, but also gives it for a moment a redundancy of electricity, a fact which must be evident from the theory, when we consider the distance at which the induction is communicated. As this charge of free electricity, for example, passes down the rod to the earth, it assumes, as it were, the form of a wave, rendering the metal negative in advance; and thus, in the transmission of free electricity through a rod of metal, the action consists of two waves, one of redundant electricity, immediately preceded by one of deficiency. Hence, if a small ball, connected with the earth by a wire, be brought near a conductor, for example, a lightning-rod, on the upper end of which discharges of electricity are thrown from an electrical machine, sparks may be drawn from the rod, however intimately it may be connected with the earth below.

This effect was strikingly exhibited by an experiment instituted by the author of this paper, which consisted in plunging one end of a copper wire, a tenth of an inch in diameter, beneath the water of a well, and throwing sparks of electricity from a globe of a foot in diameter on the upper end, which was terminated by a small ball. Although in this case the conductor was as perfect as possible, yet sparks sufficiently intense to explode the oxy-hydrogen pistol were obtained throughout the whole length of the wire.

This effect was not due, as some have supposed, to the tendency of the electricity to seek another passage to the earth, as may be shown by catching the spark in a Leyden jar; but it was solely the effect of a transient charge of electricity passing along the surface of a conductor from one extremity to the other.

The phenomena may be expressed generally by the statement that, when electricity is thrown, as it were, explosively, by a disruptive discharge through the air, on the end of an insulated conductor, it does not pass silently to the earth, but tends, in part, to be given off in sparks to all surrounding bodies. It is on this account that we object to the otherwise admirable arrangement of Sir W. Snow Harris for the protection of ships from lightning. Though the main portion of the discharge of electricity is transmitted innoxiously to the ocean by means of the slips of copper which are carried down along the mast, and through the bottom of the vessel to the sheathing beneath, as proposed by him, yet we consider it safer to conduct it across the deck, and over the sides of the vessel to the copper sheathing.

It is true, the quantity which tends to fly off laterally from the rod, is small, yet we have shown, by direct experiment, that it is sufficient, even when produced by the electricity of a small machine, to set fire to combustible materials; and, therefore, it cannot be entirely free from danger in a ship, for example, loaded with cotton.

The atoms of electricity, in their transfer from one body to another, still retain their repulsive energy; and, if the discharge be not very large in proportion to the size of the conductor, it will principally be transmitted at the surface.

If the charge be very large, and the conductor small, it will probably pervade the whole capacity, and, as we have seen, in some cases,

will convert into an impalpable powder or vapor the solid particles. Because electricity in a state of rest is found disturbed at the surface of a body, it was immediately assumed, without examination, that electricity in motion passed along the surface; but this conclusion was supposed to be disproved by the fact that the conducting power of a wire for galvanic electricity is in proportion to the area of the cross section, from which it follows that this kind of electricity pervades the whole mass of the conductor. But galvanic electricity differs from common electricity, apparently in the exertion of a much less energetic repulsion, and in a greater quantity developed in a given time. The deduction, therefore, from the experiments with galvanism can scarcely be considered as conclusive in regard to frictional electricity.

To settle this point, the author of this paper instituted a series of experiments, which conclusively proved the tendency of electricity of high tension, that is of great repulsive energy, to pass along the surface. It will be sufficient to give as an illustration of this fact, the result obtained by the arrangement represented in Fig. 11, in which A B is

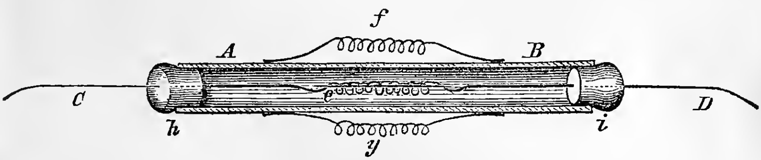


Fig. 11.

a copper wire, one of the best conductors of electricity, of the size usually employed for ringing door-bells, passing through the axis of an iron tube, or a piece of gas-pipe, about three feet long. The middle of this wire was surrounded with silk, and coiled into a magnetizing spiral, into which a large sewing needle was inserted. The wire was supported in the middle of the tube by passing it through a cork at each end, covered with tin-foil, so as to form a good metallic connection between the copper and the iron. *f* and *y* are two other magnetizing spirals of iron wire, on opposite sides of the tube, the ends soldered to the iron. When these two spirals were also furnished with needles, and a discharge from a Leyden jar sent through the apparatus, as if to pass along the wire, the needle inside of the iron tube was found to exhibit no signs of magnetism, while those on the outside presented strong polarity. This result conclusively shows that, notwithstanding the interior copper wire of this compound conductor was composed of a material which offered less resistance to the passage of the charge than the iron of which the outer portion was formed, yet when it arrived at the tin-foil covering of the cork, it diverged to the surface of the tube, and still further diverged into the iron wire forming the outer spirals. We must not conclude, however, from this experiment that the electricity actually passes on the outside of the tube. On the contrary, we must infer from the following fact, that it passes just within the surface. If the iron be coated with a thin covering of sealing-wax, the latter will not be disturbed when a moderate dis-

charge is passed through it, though with a large discharge in proportion to the conducting power of the rod, the outward pressure may become sc great as to throw off the stratum of sealing-wax. This point is of some importance in regard to the question of painting lightning-rods. If the metal is of sufficient size to freely transmit an ordinary discharge from the clouds, the condition of the exterior surface can have but little effect, and we see no objection to coating it with black paint, the basis of which is carbon, a good conducting material.

It is also to the same repulsive energy that we may attribute the spreading of a discharge when it passes through partial conductors, as in the case in which a spark from an electrical machine is transmitted over a pane of glass on which particles of iron filings are sparsely scattered. It is probable that drops of rain and partially condensed vapor in the atmosphere in some cases are connected with a similar appearance of discharge of electricity in the heavens.

A much longer spark of electricity can be drawn through rarified air than through that of ordinary density. The light which accompanies a discharge in this case assumes different colors, the violet predominating. This is a fact of interest in connection with the color exhibited by lightning, and we may infer that the discharges of a violet hue take place between clouds at a great elevation in the atmosphere.

The electric spark, when passed through a confined portion of atmospheric air, is found to produce a chemical combination of its component parts, namely, nitrogen and oxygen, and to form nitric acid. The same result is produced on a grand scale in the heavens during thunder-storms; hence the rain water which falls, in the summer season especially, always contains a considerable quantity of nitric acid, which is considered by the chemist as furnishing a portion of the nitrogen essential to the growth and development of the plant, and to the same source is referred the nitric acid in the nitrate of lime and potash which is found in the form of efflorescence on damp ground and the walls of old buildings. Indeed, all the nitrate of potash from which gunpowder is manufactured is supposed to have its origin in this way, and the explosion from the thunder-cloud, and that from the cannon, are the counterparts of each other.

Again, during the transmission of electricity from an ordinary electrical machine, a pungent odor is perceived, something analogous to that produced by the slow combustion of phosphorous, which, by a long-continued series of researches, Professor Schönbein has shown to result from a change in the oxygen of the air. He supposes that this substance is composed of two atoms, which, by their combination, partly neutralize each other, but which are separated by the repulsion of the electric spark, and thus free have a much greater tendency to combine with other substances than in their ordinary state of union. Oxygen, thus changed, according to Schönbein, is called ozone, and, as it would appear, performs an important part in many of the molecular and chemical phenomena of the atmosphere. To this increased combining power of oxygen may be attributed the formation of the nitric acid we have mentioned, and without such an explanation, it would be difficult to conceive how particles of oxygen and nitrogen, which are rendered

mutually repulsive by the electrical discharge, should enter into chemical combination.

We have seen that though metals are generally good conductors, yet when electricity falls upon a rod of iron or copper explosively, the energetic repulsion, which must always accompany these explosions, tends to throw the particles off on all sides, and when the discharge is sufficiently great, the conductor itself is dissipated in vapor. Water is a much inferior conductor to iron, and though a large mass of it will silently discharge a conductor, yet it offers great resistance to the transmission of electricity explosively, and hence the electricity is sometimes seen to leave a conductor, and pass a considerable distance over the surface of water, rather than to force its passage through the interior of the mass. It is, therefore, highly important in arranging lightning rods that they should be connected at the lower end with a large surface of conducting matter, to prevent, as far as possible, the fluid from leaving the rod in the case of an explosive discharge.

ELECTRICITY OF THE ATMOSPHERE.

Having given in the preceding sections a brief exposition of the general principles of electricity, we are now prepared to apply these to an exposition of the phenomena of atmospheric electricity.

The origin of the electricity of the atmosphere has long occupied the attention of physicists, and at different times they have apparently settled down on some plausible hypothesis, which merely offered a probable explanation of the phenomena without leading to new facts or pointing out new lines of research.

The earth, as is now well known, is almost a perfect conductor for the most feeble currents of electricity, provided the contact with it of the electrified body be sufficiently broad. The ærial covering which surrounds it, however, is a non-conductor which is capable of confining electricity in a condition of accumulation or of diminution, and of preventing the restoration of the equilibrium which, without the existence of this isulator would otherwise take place.

The hypothesis was at first advanced that the earth attracted the ethereal medium of celestial space and condensed it in a hollow stratum around the whole globe; that the electricity of the atmosphere was due to the action of this exterior envelope. Dr. Hare, our countryman, has presented this hypothesis with considerable distinctness. Without denying the possibility or even probability of such a distribution of electrical excitement, we may observe that, if this electrical shell were of uniform thickness, and we see no reason to suppose it should vary in different parts in this respect, it would follow from the law of central forces, that it could have no effect in disturbing the equilibrium on the surface or in the interior of the earth; a particle of matter remaining, as we have seen, at rest or unaffected at any point within a hollow sphere. This fact appears to militate against the truth of this assumption.

Another hypothesis attributed the electricity of the atmosphere to the friction of the winds on each other and on the surface of the earth,

but careful experiments have shown that the friction of dry air on air or of air on solids or liquids does not develop electrical phenomena.

The next hypothesis was advanced by Pouillet; which referred the electricity of the atmosphere to the evaporation of water, particularly that which contained saline ingredients. But when pure water is carefully evaporated in a space not exposed to the sky, no electricity is produced except by the friction of the sides of the vessel in the act of rapid ebullition; and when the experiment is made with salt water, the electrical effects observed are found to be produced by an analogous friction of the salt against the interior of the vessel. When pure water is evaporated under a clear sky, the vapor produced is negatively electrified; but this state is contrary to that in which the atmosphere is habitually found.

Pouillet also supposed that the process of vegetation was a source of disturbance of the electrical equilibrium, but this has not been supported by critical experiments.

The discovery accidentally made a few years ago of the great amount of electricity evolved in blowing off steam from the boiler of a locomotive, seemed to afford a ready explanation of the electrical state of the atmosphere. It was then attributed to the condensation of the ærial vapor. Faraday, however, conclusively proved by one of his admirable series of model experiments, that this effect was due entirely to the friction of the water which escaped in connection with the steam on the side of the orifice through which the discharge took place. When dry steam, or that which is so heated as to contain no liquid water, was blown out, all electrical excitement disappeared; and when condensed air, even at elevated temperatures, was discharged from an insulated fountain, no electricity was produced.

The celebrated physicist of Geneva, Professor De la Rive, refers the electricity of the atmosphere to thermal action. It is well known that if the lower end of a bar of iron, or of any other metal not readily melted, be plunged into a source of heat while the upper end remains cool a current of electricity will flow from the heated to the cooled end, the former becoming negative and the latter positive, and that these different states will continue as long as the difference of temperature is maintained. Now, according to Professor De la Rive, a column of the air is in the same condition as the bar of metal—its lower end is constantly heated by the earth, and its upper cooled by the low temperature of celestial space. Unfortunately, however, for this ingenious hypothesis, a column of air is a non-conductor of electricity, while a bar of metal is a good conductor, and it still remains to be proved that such a distribution of electricity as that we have described relative to the bar of metal can be produced in a column of air.

The foregoing are the principal hypotheses which have been advanced to account for what has been considered the free electricity of the atmosphere. After an attentive study of the whole subject, we have been obliged to reject them all as insufficient, and compelled, in the present state of science, to adopt the only conclusion which appears to offer a logical explanation of all the phenomena, namely, that of Peltier, which refers them not to the excitement of the air, but to the inductive action of the earth primarily electrified.

The author of this theory, we are sorry to say, did not receive that attention which his merits demanded, nor his theory that consideration to which so logical and so fruitful a generalization was justly entitled. Arago, in his great work on the phenomena of atmospheric electricity, does not allude to the labors of Peltier, but perhaps the reason of this is that this work was not intended as a scientific exposition of the principles of the phenomena, but merely a collection and classification of observed facts.

Peltier commenced the cultivation of science late in life, and, since the untutored mind of the individual, like that of the race, passes through a series of obscure and complex imaginings before it arrives at clear and definite conceptions of truth, it is not surprising that his first publications were of a character to command little attention, or, indeed, to excite prejudice, on account of their apparent indefinite character and their want of conformity with established principles. His theory of atmospheric electricity requires to be translated into the ordinary language of science before it can be readily comprehended even by those best acquainted with the subject, and hence his want of appreciation may be attributed more to the peculiarities of the individual than to the fault of the directors of the science of the French Academy.

According to the theory of Peltier, the electrical phenomena of the atmosphere are entirely due to the induction of the earth, which is constantly negative, or what, in the theory of Du Fay, is called resinous. He offers no explanation, as far as we know, of this condition of the earth, which, at first sight, would appear startling, but, on a little reflection, is not found wanting in analogy to support it. The earth is a great magnet, and possesses magnetic polarity in some respects similar to that which is exhibited in the case of an ordinary loadstone or artificial magnet. This magnetism, however, is of an unstable character, and is subjected to variations in the intensity and in the direction of its polar force. In like manner we may consider the earth as an immense prime conductor negatively charged with electricity, though its condition in this respect may, like that of its magnetical state, be subject to local variations of intensity, and perhaps to general as well as partial disturbance. It may be said that this merely removes the difficulty of the origin of the electricity of the atmosphere to an unexplained cosmical condition of the earth, but even this must be considered an important step in the progress of scientific investigation. The hypothesis of Peltier has since his death been rendered still more probable by the labors of Sabin, Lloyd, La Mont, Bache, and others, in regard to certain perturbations of the magnetism of the earth, which are clearly referable to the sun and moon. It must now be admitted that magnetism is not confined to our earth, but is common to other, and, probably, to all the bodies of our system; and, from analogy, we may also infer that electricity, a coördinate if not an identical principle, is also cosmical in its presence and the extent of its operation. That the earth is negatively electrified was proved by Volta at the close of the last century. For this purpose he received the spray from a cascade on the balls of a sensitive electrometer; the leaves diverged with negative electricity.

This experiment has been repeated in various parts of the globe, and always with the same result. That it indicates the negative condition of the earth is evident, when we reflect that the upper level from which the water falls must be considered as the exterior of the charged globe, and hence must be more intensely electrified than points nearer the center. Since the earth is, as a whole, a good conductor of electricity, as shown by the operations of the telegraph, the electrical tension of it cannot differ much in different parts, and we are at present unacquainted with any chemical, thermal, or mechanical action on land of sufficient magnitude to produce this constant electrical state. We are therefore induced to adopt the conclusion that the earth, in relation to space around it, is permanently electrical; that perhaps the ethereal medium, which has been assumed as the basis of electricity, as was supposed by Newton, becomes rarer in the vicinity and within bodies of ponderable matter. Be this as it may, all the phenomena observed in the atmosphere, and which have so long perplexed the physicist, can be reduced apparently to order, and their dependencies and associations readily understood, in accordance with the foregoing assumption. This is not a mere vague supposition, serving to explain in a loose way certain phenomena, but one which enables us not only to group at once a large class of facts which, from any other point of view, would appear to have no connection with each other, but also to devise means for estimating the relative intensity of action, and to predict, both in mode and measure, changes of atmospheric electricity before they occur. It follows, as a logical consequence from this theory, that salient points, such as the tops of mountains, trees, spires, and even vapors, if of conducting materials, will be more highly excited than the general surface of the globe, in a manner precisely similar to the more intense excitement of electricity at the summit of a point projecting from the surface of the prime conductor of an ordinary electrical machine.

It also follows, from the same principle, that if a long metallic conductor be insulated in the atmosphere, its lower end, next the earth, will be *positive*, and the upper end *negative*. The natural electricity will be drawn down by the unsaturated matter of the earth into the lower end of the wire, which will thence become redundant, while the upper end will be rendered negative, or under saturated. That this condition really takes place in the atmosphere was proved in a striking manner by the experiment of Guy Lussac and Biot, in their celebrated ærial voyage, which consisted in lowering from the balloon an insulated copper wire, terminated at each end by a small ball. The upper end of this was found to be negative, and consequently the lower end must have been positive, since the whole apparatus, including the balloon, was insulated. The experiments should be repeated at different elevations by some of our modern æronauts, since the results obtained would have an important bearing on the theory of atmospheric electricity.

The same results may be shown in a simpler manner by the method invented by Saussure. This consists in attaching a leaden ball to a long wire covered with silk or varnish, connected by means of a

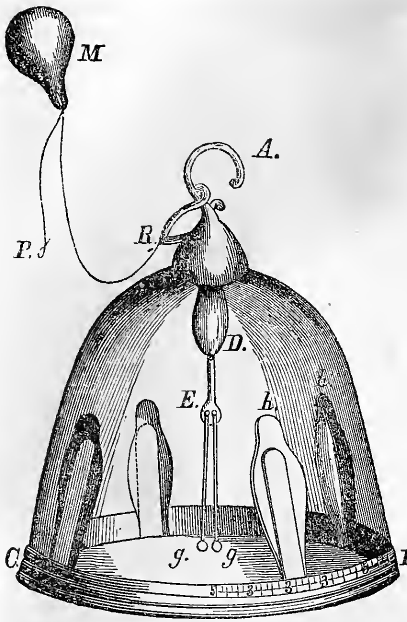


Fig. 12.

slight spring to the hook of an electrometer. When this bulb is thrown upward so as to rise to a considerable height in the air, by means of a string and handle *p*, the wire is disconnected from the electrometer, and the pith balls of the latter diverge with positive electricity. That this effect is not due to the friction of the bulb and the air, is shown by whirling it in a horizontal circle round the head—not the least sign of electricity in this case will be exhibited; and that it is not charged by absorbing free electricity from the air is proved by the fact that when the ball is thrown horizontally no excitement is manifest. The result is, however, just such as would be produced by the induction of the earth acting on the natural electricity of the wire and drawing it down to its lower extremity. A precisely similar effect would also be produced if the upper surface of the atmosphere were charged with this electricity. The intensity of the charge which the electrometer receives will depend upon the elevation to which the ball ascends, or, in other words, on the perpendicular component of the wire.

The method employed by Saussure in observing the variations of the electricity of the atmosphere,


Fig. 13.


Fig. 14

illustrates the same principle. For this purpose he made use of one of his own electrometers, which is shown in Fig. 12. It consists of a bell-glass with a brass stem, D E, surrounded with sealing-wax, and two small pith balls, *g g*, suspended by very fine wires. C B is a metallic foot, and *h h* slips of tin-foil pasted on the inside and outside of the glass to discharge the pith balls when the electricity is so strong as to cause them

to strike the glass. To measure the electrical intensity with this instrument, the hook *A* was removed, and its place supplied with a pointed brass rod. The electrometer was first brought in contact with the ground as exhibited in Fig. 13; then held vertically as shown in Fig. 14, and gradually elevated until the leaves began to diverge. He found that the height to which the instrument required to be elevated before the leaves showed signs of electricity, varied at different times, and he estimated the intensity of the electricity of the atmosphere by the inverse ratio of this height.

The explanation of this will be readily seen by a reference to Fig. 15, in which C D represents a portion of the surface of the earth negatively charged, and *a b c* a perpendicular conductor terminated above and below by a bulb. In this condition the unsaturated matter in C D will act upon each atom of the fluid in the conductor, and tend to draw the whole down into the lower bulb; the atom *a* will not only be attracted downward by the action of the earth on itself, but also pressed downward by the attraction of the earth on all the atoms above it, and hence the intensity of the electricity of the lower part of the conductor will be increased by an increase in the perpendicular length of the rod. Now, if we connect the lower bulb of the rod with the earth by means of a good conductor, the redundant electricity of the lower end will be drawn off into the earth and will no longer react by its repulsion on the electricity of the rod to drive it back into the upper bulb, and hence this will become intensely negative; and in this condition it will be a salient point on the surface of the earth. If, while the apparatus is in this condition, we could touch the upper ball with an electrometer, it would exhibit a negative charge.

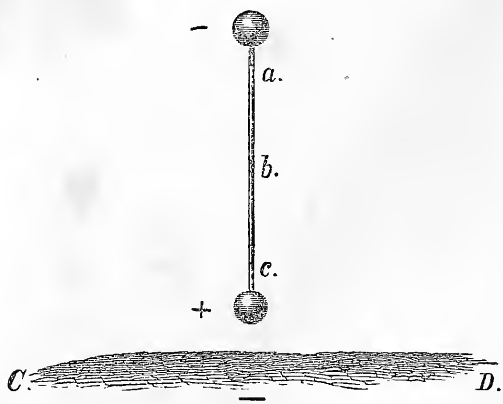


Fig. 15.

If a conductor 20 feet in length were made to revolve on a horizontal axis, passing through the middle of its length so that it could be immediately changed from a horizontal to a vertical position, any change in the apparent condition of the atmosphere would be shown by the greater or less intensity of the balls, as, in succession, they passed the lower point of their circuit; and an apparatus in the form of radiating conductors like the spokes of a wheel, if made to revolve, would furnish a constant source of electricity. An apparatus of this kind was constructed by M. Palmeri, of Italy, and might be used perhaps with success in studying the condition of the atmosphere in ascensions.

The most convenient apparatus, however, for exhibiting electricity

by the induction of the earth, is that invented by M. Dellman, and shown in Fig. 16:

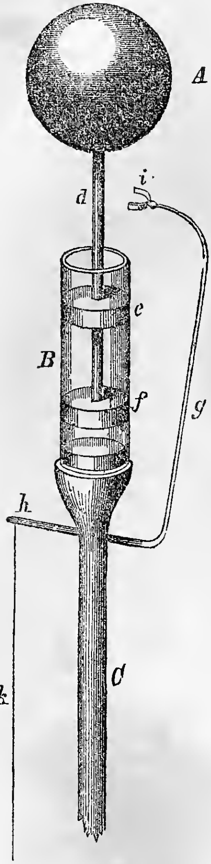


Fig. 16.

A is a brass ball, supported on a thick brass stem, which is insulated inside of a glass tube, by passing through corks of gum shellac. The apparatus is fastened to a pole, which is temporarily elevated, by a windlass or the hand, on the top of a house into the air. When it reaches the height intended, the wire *k*, connected with the earth below, is pulled, the end of the metallic bent lever *g h* is depressed, and the fork *i* brought into contact with the stem of the globe, and thus a perfect metallic connection is formed between the latter and the ground. The wire *k* is then released; the lever falls back; the ball is cut off from the earth, brought down, and applied to an electrometer, and in all cases, when the sky is clear, is found to be negatively electrified. If the wire *k* be insulated through its entire length, and terminated in a bulb at a little distance from the earth, and a pull be given to it by means of a rod of glass, at the instant of contact of the point *i* with the stem *d*, the lower bulb will exhibit a positive charge of electricity.

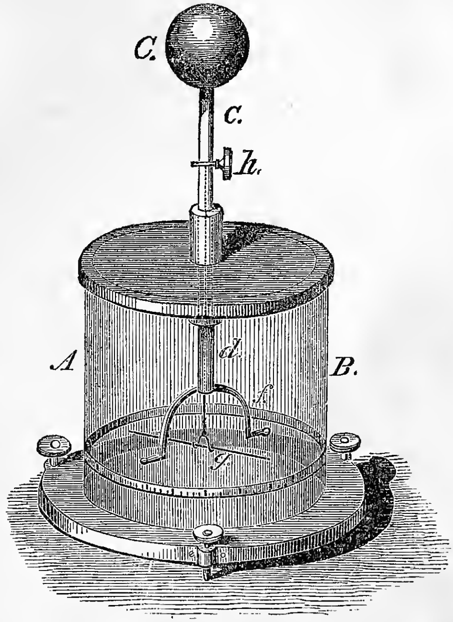


Fig. 17.

The arrangement will, in fact, be precisely the same as that exhibited in the previous figure, [Fig. 15,] namely: a vertical conductor, in which the upper end is rendered *minus*, and the lower end *plus*, by the induction of the earth. This effect is entirely due to induction, and is independent of any free electricity which may exist in the air. The results are exhibited with the greatest intensity during perfectly clear and dry weather, and are not observed when the conductor is placed horizontally,

but with increased effect as its upper end is gradually brought nearer the perpendicular.

That these effects are not due to the free electricity of the atmosphere, is conclusively proved by the original experiments of Peltier. For measuring the intensity of the inductive influence of the earth, he made use of an electrometer represented in Fig. 17. In this, *A B* is a glass cylinder, furnished with a wooden foot and a glass cover, in the center of which is cemented a brass tube, carrying a ball *C* at the top, and a bent wire *f* at the bottom. At the level of the bent wire *f* is suspended a fine magnetized needle *g*, the height of which is adjusted by the screw *h*. The intensity of the electricity is measured by the divisions pointed out by the needle on the slip of paper surrounding the cylinder. This instrument, which is very sensitive, has been modified and improved by Dellman.

On the top of the flat roof of his house Peltier placed a flight of steps by which he could ascend with an electrometer in his hand similar to that we have just described, armed with a comparatively large sized polished ball. The ball of the electrometer was held at the height say of four feet above the roof of the house, and in this position it was touched by the end of a wire connected with the earth below. It thus formed the termination of a perpendicular conductor, and was, of course, negatively electrified—the bulb more intensely than the leaves below, but the stratum of air in which it was placed being in the same state, it exhibited no signs of electricity. It was then elevated by ascending the steps to the height of six feet above, and held by the lower plate. The leaves in this case diverged with negative electricity because the ball was still further removed from the earth, and the attraction of which being lessened, the part of the electricity which was in the leaves was set free, and ascended up the bulb by repulsion, leaving a deficiency in the leaves. When the electrometer was brought down to its first position, the leaves again collapsed, since there was again an equilibrium; and when the electrometer was depressed below its normal position, the leaves became positively electrified by the increased attraction of the earth, and in this way the electrometer was made to diverge, to converge, and diverge again, by simply changing its elevation.

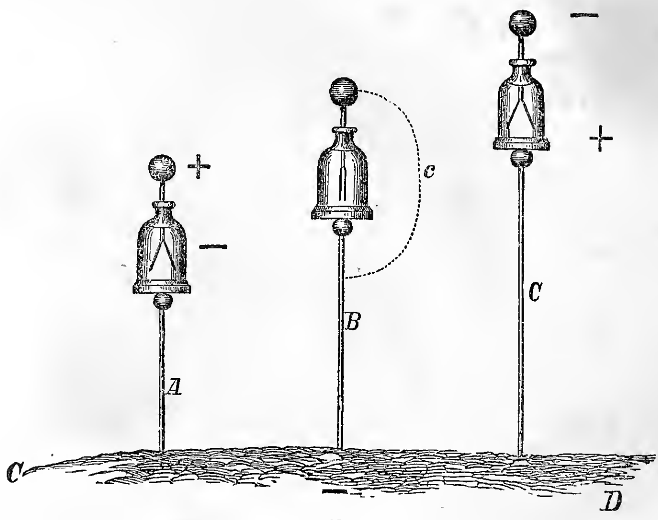


Fig. 18.

Fig. 18 is intended to illustrate the condition of the electrometer

in the three positions, in which it is supposed to be supported on three metallic conductors of different heights. The electrometer brought into neutral condition by the ball, is shown in the middle of the figure at *B*, in which the connection of the rod with the ball is indicated by the dotted line. When the electrometer is raised by the hand to a higher elevation, its condition is exhibited by *C*, in which the greater elevation of the rod beneath it causes a greater amount of electricity to be drawn down, and the top of the rod and the bottom of the electrometer in connection with it, to become more intensely negative, and hence to draw down into the leaves a portion of the natural electricity of the ball, and cause the former to diverge with positive excitement relative to the air around.

The condition of the electrometer when brought to a lower level is illustrated by A, in which the shortening of the conductor reduces the number of atoms on which the electricity of the earth acts, and hence those at the top are more pressed upward by their self-repulsion than in the former case, consequently a portion of the natural electricity is driven into the upper ball, and the leaves themselves diverge with a negative charge.

The writer of this article had the pleasure, in 1837, to witness this interesting experiment, as performed on a dry clear day by Peltier himself.

In order that the result may be shown with a slight change of elevation, it is necessary that a large ball be employed, that the effect may be multiplied by all the electricity of the large surface. When the electrometer is terminated with the point of a fine needle, though this is the best means of attracting electricity from the air at a distance, no effect will be exhibited, although the apparatus may be exposed to the atmosphere for several hours, provided the weather is dry and the sky cloudless.

From these experiments it appears conclusive that the positive electricity with which the air is apparently always charged in dry and clear weather is not due to the free electricity of the atmosphere, but to the induction of the earth on the conducting materials of which the instruments are in whole or in part composed.

It is not difficult to deduce from the same general principles the apparent changes in the electrical state of the atmosphere at different times of the day and in different hygrometrical conditions of the air. Vapor of water mingled with the atmosphere renders the latter a positive conductor; and when the moisture of the air extends up as high as the upper part of the apparatus in Fig. 16, a feeble negative electricity will, by slow conduction, be diffused through the adjacent strata, which, acting upon the ball A, will lessen the effect of the more intense action of the earth. While the latter tends to draw the atoms of natural electricity of the conductor down into its lower part, and to render the upper end negative, the vapor around the ball will tend to draw it slightly upward, and thus diminish the effect, and lead the casual observer to suppose that the air is less positively electrified. Peltier in this way has shown, as well as Quetelet and Dellman, that the variations of the electricity of the atmosphere observed from day to day, and at different times in the

twenty-four hours, correspond inversely with the variations in the amount of vapor.

The experiments we have thus far described are intended to establish the inductive character of the atmosphere in its condition of dryness and serenity, particularly during clear and cold weather.

We have employed movable conductors terminated by balls, which have been of the most favorable form and relative dimensions to exhibit the effects of induction. The apparatus, however, usually employed before the experiments of Peltier, were principally stationary insulated conductors, terminated by points above, which, as we have seen, act powerfully in discharging electricity from a body, or in absorbing it from the surrounding medium.

If in the experiments with the apparatus, Fig. 16, the rod be terminated by a point instead of a ball, but feeble excitation will be observed during clear cold weather, because the point exhibits so exceedingly small a surface that but very little electricity can be drawn down into the lower end, before the intensity of attraction of unsaturated matter upwards comes into an equilibrium with the attraction of the earth downwards. With this instrument the observer would probably make a record to the effect that the electricity of the atmosphere was very feeble, whereas if the experiment were made with the apparatus previously described, an opposite condition would be noted. The result, however, would be entirely different if the air were damp and the insulated rod elevated to a considerable height, the negative intensity of the upper end would be sufficient to attract a portion of the natural electricity from the surrounding medium, even although this had become slightly negative by the previous induction of the earth. In this case the pointed conductor would indicate a large amount of electricity.

The intensity of the induction may even become so great as to absorb a portion of the natural electricity of the dry atmosphere, as in the case of a very long wire, the upper end of which is furnished with a series of points, and raised to a great height by means of a kite. The points may attract a portion of the natural electricity of the air, and thus produce at the lower end of the wire a series of sparks, following each other, after the lapse of a certain time, at regular intervals.

From the foregoing, it will be evident that in interpreting the indications of the two classes of instruments we have described, which may be denominated those of induction and those of absorption, we must keep constantly in view the principles which have been explained; and it is for want of a clear appreciation of these principles that so much complexity has been introduced in the otherwise comparatively simple effects of induction.

ELECTRICITY OF THE CLOUDS.

The explanation of the thunder-storm and the tornado given by Peltier does not appear to us as satisfactory as could be desired. In common with most of the meteörologists of Europe, he does not take into consideration the real character of the storm, which, as we think, has been fully established by theory and observation in this country.

We have stated in a previous report that this consists in the rushing up of the lighter air to restore the normal equilibrium of the atmosphere, which had been disturbed or rendered unstable by the gradual introduction, next to the ground, of a stratum of warm and moist air. As an illustration of this disturbance, we may mention the fact pointed out to Arago, by Captain Hessard, which he had observed in the Alps, namely, that during great heats there takes place suddenly at the lowest stratum of clouds, upward rushings, extending vertically like rockets.

We shall endeavor to supply the deficiency, in the exposition of Peltier, we have mentioned, and to present, on the principles of the induction of the earth in connection with the upward motion of the air, a logical explanation of the origin and continued supply of the great quantity of electricity developed in the meteors under consideration.

It follows, from the principles of induction, that the upper end of all perpendicular insulated conductors must be electrified negatively, and the lower end positively, since the attraction of the unsaturated matter of the earth below will draw down the natural electricity of the conductor into its lower extremity, leaving a deficiency in the upper part. Now, if we admit, agreeably to the theory of Mr. Espy, that a cloud consists in the upward motion of a mass of moist and heated air, the vapor of which is condensed as it ascends into the colder regions, thus forming a high perpendicular column of partially conducting material, it will be evident that by induction, the upper part of this cloud will become negatively electrified, and the lower part positively, as in the case of the conductor, Figure 15. The intensity of this excitement will depend upon the length of the vertical dimensions of the cloud, which, in many cases, is exceedingly great, and also upon the density, and consequently the conducting power of the vapor. The induction of the earth being very intense, a partial excitement of the atoms of vapor may take place even before the condensation of the whole mass has reached its maximum. If this be the case, a transparent mass of vapor, or that which is merely beginning to condense into cloud, will be electrified throughout its entire mass; and when the condensation of the vapor has gone so far as to render the interior a tolerably good conductor, the electricity of each atom will be repelled to the surface, as in the case of a globular conductor; the intensity

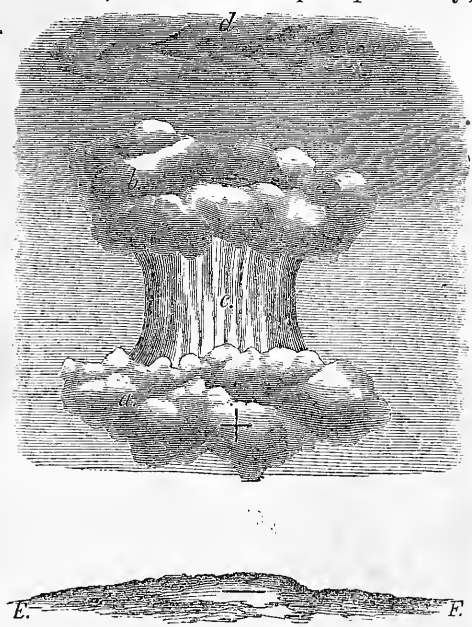


Fig. 19.

will thu be highly increased; and while the rushing upward of moist air is going on, a series of discharges will take place between the upper and lower portions of the cloud.

It is asserted by Mr. Wise that the thunder cloud, when viewed on one side from a sufficient elevation, presents the appearance of an hour-glass, the upper and the lower ends spreading out almost into two distinct clouds, as seen in Figure 19.

We find that the same form of the thunder cloud has been described by other ærial voyagers, also by Volta; and we are inclined to consider it the usual one presented by this meteor, since it is precisely that which would be produced by the self-repulsion of the upper and lower parts of the cloud, each charged, as it is throughout its mass, with the same kind of electricity. The middle of the perpendicular dimensions of the cloud, as illustrated by the perpendicular conductor Figure 15, will be neutral, and hence no tendency to bulge out at this point will exist. Mr. Wise also states that flashes of sheet lightning are constantly seen at *c*, in the middle space; and sometimes intense discharges from the upper to the lower part of the cloud—appearances in exact conformity with the views here presented.

The immense number of discharges of lightning from a single thunder cloud in its passage over the earth, through a distance in some cases of more than 500 miles, indicates a constant supply of electricity; and this is found in the continued rushing up of new portions of moist air, and, as it were, in the successive renewals of the perpendicular column with fresh materials, the electrical equilibrium of which is disturbed by induction.

In the case of a tornado or water-spout, the ascending current of air is confined to a very slender column, in which the action is exceedingly intense; and since it is scarcely possible that the rushing in from all directions of the air below to supply the upward spout can be directed to precisely the same central point, a whirling motion must be produced. This will tend to limit the diameter of the spout, and to create a partial vacuum at the axis of the column, in which the moist air, by the cold of the sudden expansion, will have its vapor condensed, and a conductor will thus be formed extending from the cloud to the earth. Through this conductor a constant convective discharge of electricity will take place, and all the phenomena described by Dr. Hare will be exhibited.

In this view of the nature of the tornado or spout, although we adopt with Franklin and Espy, as the characteristic of the commotion of the atmosphere, the rushing upwards in the form of a column, on the principles of hydrostatics, of a stratum of heated and moist air, which had accumulated at the surface of the ground, yet the phenomena are modified and increased in number by the great amount of electricity which must be evolved by the simple action of the continued elevation of new portions of a constant stream of moist air. Since the conductor, in the case of the tornado or water-spout, extends to near the earth, and the discharge is continually taking place, the cloud, which is spread out immediately above, will be negatively electrified, and the upper portion of the cloud, as exhibited in Figure 19, will be wanting.

The greater or less degree of conduction of the depending spout will vary the phenomena and give rise to the different appearances which have been seen at the surface of the water. When the conductor does not quite reach to the earth, visible discharges of electricity will be exhibited, and the surface of the water will be attracted upwards. When the conducting material of the spout touches the surface of the water, the liquid will be depressed.

That the rushing up of the air with intense violence does take place in the column of a land or water spout is abundantly proved by direct observation, and that electricity cannot be the cause of this action, but is itself an effect, is proved by the fact, that since the column of moist air extends to the earth, through it discharges of the fluid must be made, which would soon exhaust the cloud, were it not constantly renewed. In some instances the meteor has been known to continue its destructive violence along a narrow line of more than two hundred miles in length. To merely refer this prolonged action to a whirling motion of the air, without attempting to explain on known principles of science, the renewed energy of the rotation, is to rest satisfied with a very partial analysis of the phenomenon.

If, by the action of an elevated horizontal current of air, the upper part of a thunder-cloud be separated from the lower, we shall have a mass of vapor charged entirely with negative electricity, and from such a mass floating high in the atmosphere, a new evaporation may take place by the heat absorbed directly from the sun. The column of invisible vapor thus produced being a partial conductor elongated upward, the attraction of the earth will draw down a new portion of its natural electricity into the cloud from which the vapor was produced, and thus diminish its negative intensity. If, now, the upper end of this transparent column be condensed by the cold of the greater altitude into visible vapor, it will form a cloud of the second order of negative intensity. We shall thus have, according to Peltier, lower clouds intensely excited with positive electricity, clouds of medium elevation either neutral or slightly negative, and the highest cirrus clouds, which are formed by the secondary evaporation we have mentioned, excited intensely with a negative electricity.

Since particles of ponderable matter similarly electrified repel each other, it is evident that the electrical state of the cloud must in some degree counteract the tendency to condensation which would result from the cold of the upper regions; and also, the same action in the lower clouds will tend to prevent precipitation in the form of rain, even though the atoms of vapor are in a condition to coalesce into drops of water.

It is evident, also, since the earth is negatively electrified, that the particles of vapor in the same state will be repelled further from the surface, and those which are positively electrified will be drawn down. Hence, the negative clouds will tend to retain their elevated position, although they may be pressed downwards by descending currents.

Negative clouds may also be formed near the surface of the earth by a detached portion of cloudy matter under a cloud more highly charged with positive electricity, which will cause the former, by induction, to

discharge its positive electricity into the earth, as well as a portion of its natural electricity; and if the upper cloud be afterwards driven away by the wind, the lower will be left highly negative.

Peltier states that he can determine from the appearance of a cloud whether it be positively or negatively charged. Clouds negatively electrified, according to him, are of a bluish grey color, while those which are positively charged are white, and exhibit at the setting sun, a red appearance.

From the foregoing considerations it must be evident that, in addition to the disturbance which is produced in the atmosphere by the variations of heat and moisture, which we have so fully discussed in the last report, we must take into account those that result from the changes in the electrical condition of the atoms of moisture. Though they may not be as important as the former, still they must modify the conditions of the general phenomena, and no theory of storms can be complete which does not include the effect of this agent.

On the principles we have developed, the discharges of lightning which are exhibited in volcanic eruptions are readily understood. The column of vapor of water, heated air, and other conducting materials, which sometimes rise to a great elevation from Vesuvius, must be subjected to the inductive action of the earth, and, consequently, the electricity of the upper end of the column, as soon as its elevation is sufficient to produce a condensation of the vapor, by the cold of the higher regions, must send down to the lower part of the column a large amount of electricity which, when the length is great, and the ascending stream rapid, will manifest itself in discharges of lightning. In accordance with the same principles, thunder storms have been produced in a peculiar state of the atmosphere, as it were, artificially. About thirty years ago a farmer at Greenbush, near Albany, collected on a knoll in the middle of a field, a large amount of brushwood, which was set on fire simultaneously at different points, and, burning, gave rise to an ascending column of heated air, extending to a great altitude. The air rushing in to supply the upward current assumed a rapid rotary motion, accompanied by a loud roaring and discharges of lightning of sufficient magnitude to frighten the laborers from the field. The explanation in this case is too obvious to require a formal statement.

In the equatorial regions, under a vertical sun, masses of moist air are constantly rising during the day time, and producing electrical discharges to the earth. The vapor, therefore, which accompanies the reverse trade winds in the upper region, must be negatively electrified, while the earth in the torrid zone must constantly be receiving electricity from the clouds. From this, we may infer, that there is a current of electricity through the earth, from the equator towards the poles, and a neutralization by means of the air above, which may give rise to the aurora polaris.

Arago has described the different forms of lightning under three classes. The first class comprises the lightning which consists of a vivid luminous line or furrow, very narrow, and sharply defined, the course of which is not a direct line, but is that denominated

zig-zag. This peculiar form of lightning, according to Moncel, is referable to the effect of partial, interrupted conduction, and may be imitated by sprinkling iron filings on a plate of glass; the bifurcations of the discharge may also be referred to the same cause. The drops of rain distributed through the air perform the office of the particles of iron filings in the experiment, and the repulsion of the electricity tending to separate it into different streams. The next class consists of what is called "sheet lightning," which, instead of being narrowed to bright sinuous lines, appears on the contrary to extend over immense surfaces. It not unfrequently has an intensely red tinge, and sometimes a blue or violet color predominates. The color, probably, belongs to the flashes of lightning which take place at a great elevation, and seems to illuminate lower clouds, and thus to present the appearance of a broad flash.

We may also mention that flashes of lightning are sometimes observed in a summer evening, without thunder, and known as "heat lightning." They are, however, merely the light from discharges of electricity from an ordinary thunder-cloud beneath the horizon of the observer, reflected from clouds, or perhaps from the air itself, as in the case of twilight. Mr. Brooks, one of the directors of the telegraph line between Pittsburg and Philadelphia, informs us that, on one occasion, to satisfy himself on this point, he asked for information from a distant operator during the appearance of flashes of this kind in the distant horizon, and learned that they proceeded from a thunder storm then raging two hundred and fifty miles eastward of his place of observation.

The third class is called "globular lightning," which is remarkable, besides its peculiar form, for the slowness of its motion. The occurrence of this form of lightning is very rare, and were not the phenomenon well authenticated, we should be inclined to regard it as a delusion. But it does not comport with the cautious procedure of true science to deny the existence of all appearances which may not come within the prevision of what are considered as established principles; although when facts of an extraordinary nature are related to us they should not be received with that easy credence which might be due to less remarkable phenomena, yet, after having fully satisfied ourselves of their reality, we must endeavor to collect all the facts connected with them, and to ascertain with accuracy the essential conditions on which they depend. Arago has given a number of instances of this remarkable form of the electrical discharge, the general appearance of which is that of a ball moving slowly through the air, and sometimes, when coming near a body, exploding with tremendous violence.

The only explanation which has been suggested for this remarkable meteor, and which, at first sight, appears to belong entirely to some other class of phenomena than those denominated electrical, is that which was in part suggested, I think, by Sir W. Snow Harris. According to his hypothesis, the ball of light is the result of what is analogous to that which is known as a glow discharge, a phenomenon familiar to all who are in the habit of making electrical experiments. When a conductor connected with the earth is brought near a charged

body, particularly when the air is damp, a partial silent discharge will take place, during which, although there may be no light perceptible in the space between the two, yet on the end of the conductor connected with the earth a glow of light will appear, attended with a hissing noise. Now, if we suppose that in the atmosphere between the cloud and the earth there exists a stratum or current of very dry air, while the remaining portions are in a very moist condition, and that the silent discharge from the cloud is taking place, for example, nearly perpendicularly to the earth, and passing through the dry stratum, then the partial interruption of conduction as the current of electricity passes through the dry stratum will give rise to the exhibition of light. Again, if we suppose the cloud to be in motion, this appearance will travel with it, and the patch or glow of light will thus exhibit in mid-air a comparatively slow progressive motion, and disappear as if with an explosion, when a disruptive discharge takes place. This hypothesis can only be considered as an antecedent possibility, and is not presented as a full or satisfactory explanation; the phenomenon itself must be more frequently observed, and the associated condition of its appearance more minutely noted before a definite hypothesis can be formed as to its cause.

Records of observations, therefore, with regard to this meteor are exceedingly desirable; they should, however, be made with scrupulous accuracy, and by persons accustomed to scientific investigations. We have found, from experience, great difficulty in obtaining an accurate account of all the circumstances attending a peculiar occurrence of nature, from those who were present at the time and witnessed the phenomenon. It is astonishing how much the products of the imagination are mingled with the actual impressions made upon the senses, and how difficult it is to separate from the testimony of a witness, what he actually saw, and what he unconsciously infers from the previous crude conceptions of his mind, awakened at the instant by a powerful association of ideas. In the transit of the meteor which passed over a considerable portion of the United States, in November last, a large number of persons declared that it fell in an adjoining field, or in the water near by, although it must have been at the time many miles in altitude above the surface of the earth.

INDUCTIVE ACTION OF THE CLOUD.

A cloud formed as we have described must produce a great inductive effect on the earth beneath, and as it is borne along from the west in this latitude over the surface of the ground, the intensity of the electricity of the lower part must constantly vary, on account of the conducting condition of the materials at or below the surface. For example, since water is a better conductor than dry earth, if the cloud is moving in a line which, if produced, would cross a river, its course will frequently be changed, and in a similar way we can explain the fact that discharges of lightning more frequently fall on some places than others. Although the cloud may be impelled in the same direc-

tion by the wind, yet the attraction of the surface of the water, rendered more than naturally negative by induction, will tend to draw it from its course. And since the induction acts at a distance through all substances, if a quantity of water or good conducting material exist below the surface of the earth, the cloud will be similarly affected. It frequently happens that when a heavy discharge of lightning passes near a house or descends along a rod, inductive effects are exhibited which are more startling than dangerous.

We have seen in the experiment described in page 477 that an induced spark was exhibited at the edge of a large disk covered with tinfoil, in the lower story, by suddenly drawing the electricity from a similar disk in the upper part of a house. A precisely similar arrangement, but on a much more gigantic scale, is presented when a highly charged thunder-cloud is in the zenith of a building. Now, if the intensity of this be suddenly diminished by a discharge to the earth, flashes of electricity and sparks from different objects within the house will be observed. The explanation of this is very easy. The free electricity of the cloud, which we may suppose to be positive, repels all the positive electricity of conductors and partial conductors into the ground, and renders them negative. They will be brought, however, into this state very gradually, either by the comparatively slow approach of the cloud, or by its increase in intensity. The fluid, therefore, will escape into the ground without being perceptible in the form of sparks, but when the repulsion is suddenly relieved, at least in part, by a discharge of the cloud, the natural electricity rushes back and exhibits itself in flashes and sparks, and even may give shocks to persons in the vicinity. Although this sudden return of the electricity from the earth into which it has been driven, in ordinary cases of conductors in a house supported by bad conducting materials, is usually attended with but slight effects; yet it may, under certain circumstances, produce serious accidents, particularly when a person is in good conducting connection with the earth. A remarkable instance of this kind was given by Mr. Brydone, in a letter to the president of the Royal Society, in 1787.

Two laborers, each driving a cart loaded with coal, and sitting upon the front part, ascending a slight eminence, the one following the other at a distance of about twenty-four yards, as represented at *M* and *L*, Fig. 20, were conversing about the thunder which was heard at a distance, when in an instant the man in the hinder cart was astounded by a loud report, and saw his companion and the two horses which he was driving fall to the ground. He immediately ran to his assistance, but found him quite dead. The horses were also killed, and appeared to have died without a struggle. The hinder cartman had the horses and driver of the forward cart full in view when they fell to the ground, but he saw no flash nor appearance of fire, and was sensible of no shock nor uncommon sensation. Each wheel was marked with a bluish spot on the tire, as if the iron had been subjected at that place to an intense heat, and directly under these spots were two holes in the ground, from which the earth was removed as if by an upward explosion. Flashes of lightning had been seen and thunder heard by

Mr. Brydone also, who was in the vicinity at the time, but these were at the distance of five or six miles, as shown by the time elapsed between seeing the flash and hearing the thunder. There were no marks, however, of the exit of the discharge upwards from the body of the man or of the horses, or any effect which could be attributed to a discharge immediately from the cloud. The accident was seen by another person, from a greater distance, who was also astounded by the loud report, saw the horses and man fall to the ground, but observed no lightning nor fire at the time, but perceived the dust arise at the place. A shepherd in a neighboring field, during the same storm, observed a lamb drop down dead, and felt at the same time as if fire had passed over his face, although the lightning and clap of thunder a were at great distance from him. This happened a quarter of an hour before the accident to the cartman, and not over three hundred yards from the same spot. A woman making hay near the bank of the river near by, fell suddenly to the ground, and exclaimed to her companions that she had received a violent blow on her foot, and could not imagine whence it came.

A scientific analysis of these phenomena is given by Earl Stanhope, on principles similar to those of induction, which we shall translate as it were into the precise language of that theory. Let us suppose a cloud eight or ten miles in length to be extended over the earth in the situation represented by A B C in Fig. 20, and let another cloud D E F

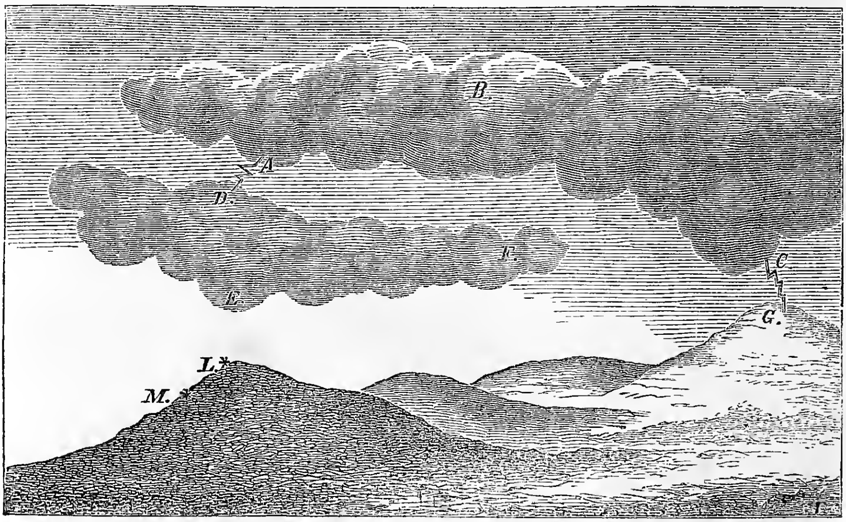


Fig. 20.

be situated between the above-mentioned cloud and the earth. Let the two clouds be supposed to be charged with the same kind of electricity, and both positive. Let us further suppose that the lower cloud D E F be only so far from the earth as to be just beyond the striking distance, and the man, cart, and horses to be at L, under the part E of the cloud which is nearest the earth. Now, let the remote end C of the upper cloud approach the earth within striking distance, and suddenly discharge itself at G. The effect which would be produced by this

arrangement, at the moment of the discharge C G, will be understood by considering the condition of the electricity in the two clouds, and in the earth a moment previous to the discharge. Both clouds being positive, the two will act upon each other by repulsion, the free electricity of the lower cloud will be driven down into its lower surface, and will be accumulated particularly in the point E nearest to the earth. The ground underneath the lower cloud, and more especially at L, where the distance is least, will become highly negative. The natural electricity will be driven down into the ground by repulsion, and will be retained there as long as this condition remains, but when a discharge takes place at the point C G, if the cloud B be a good conductor, the repulsion at A and D will be suddenly removed, and the natural electricity of the earth will return with a rush to the surface, and pass beyond its point of natural equilibrium, as in this case into the man and horses. The loud report was caused by the discharge from D to A, which was invisible to the eye of the spectator on account of the density of the lower cloud.

An experimental illustration of the effects produced in this case may be readily furnished by charging two conductors, arranged in the relative position of the two clouds. At the moment a spark is drawn from the end C, a discharge is observed at D A. The death of the lamb, and the shock felt in the foot of the woman were both produced according to this view, by the sudden rushing up of the natural electricity of the ground, when the repulsion in the upper cloud was in part diminished by the distant discharge.

The inductive action at a distance which we have described, affords a rational exposition of the effects which are perceived by persons of nervous sensibility on the approach of a thunder-storm, and may also be connected with the change which is said to take place suddenly in liquids in an unstable condition, such as the souring of milk and other substances, near the point of fermentation. But whether the latter effects are due to the inductive action of the electricity or the tremor produced by the thunder, has not, to our knowledge, been definitely settled. If the effects are due to induction, it is probable that they would be greater in the case of milk in a metallic pan resting on the earth, than in one of glass, supported on glass legs or a thick cake of beeswax.

PRECAUTIONS WITH REGARD TO LIGHTNING.

Men have often been struck by lightning in open plains, and since the human body is a good conductor of electricity, from the principles we have given it must be evident that when standing it would be more likely to be struck than any point on the earth in the vicinity. There is less danger in a horizontal position, particularly if the person be resting on some non-conducting substance which would prevent the natural electricity from descending into the earth. Near the foot of a tall isolated tree is always considered a dangerous position, and this is in accordance not only with facts but well-established principles. The upper part of the tree being a partial conductor, particularly if covered with foliage, will become electrified by induction, will attract the dis-

charge to itself, and in the passage of the lightning toward the earth it will act with energetic induction on all surrounding objects, and since the body of the man is a better conductor than the wood, the instantaneous inductive effect of the descending bolt will be greater on the head of the man than on the remaining part of the tree in its descending course, and hence it will diverge from the line it was pursuing, break through the air, and pass through the body of the man. To attempt to explain this phenomenon, by merely saying that the electricity leaves the tree because the human body is a better conductor than the wood, is to attribute to this agent prescience and forethought, but by an application of the principles of induction, the whole is referred to the simple action of attraction and repulsion. In the interior of a house, the safest position we can well imagine is that of being horizontally suspended in a hammock by silk cords in the middle of a room, and perhaps the next, that of lying on a mattress or feather bed on a wooden bedstead, the materials of which are very imperfect conductors. It is scarcely necessary to say that if the bedstead be in the middle of the room, at a distance from the wall, the danger will be less.

It may, perhaps, be well to dwell for a moment on the explanation of the foregoing statement. Let us suppose a man to be standing on a large piece of beeswax, which is almost a perfect non-conductor, and exposed to a cloud highly charged with positive electricity A portion of the natural electricity of his head would be drawn down into his feet; the former would become negatively electrified and attract the lightning of the cloud, while the latter would repel it; the tendency to be struck would be on account of the difference of these two actions. If the man stepped off the non-conducting wax on to the earth, the redundant electricity which had collected in his feet would be discharged, his head would become still more negatively electrified, the repulsion which existed in the other case would disappear, while the attraction would be increased, and hence the tendency to be struck would be much greater.

Let us next consider what would take place if a man should be extended horizontally on a large disk of beeswax. In this case the upper part of the body, or that toward the sky, would become negative, and the lower part, or that in contact with the beeswax, would become positive, and the attractions and repulsions would be exhibited as in the first instance, but with less energy, because their foci would be much nearer each other, and consequently they would act with almost equal effect; while the repelled electricity not having space into which to descend, a less quantity of it would be repelled from each point of the upper surface. If the disk of wax were placed above the man's head while in a standing position, it would not screen the repulsive energy of the cloud, which, like gravitation, acts through all bodies; the induction would take place as before, the head would become highly negative, while the natural electricity which had been driven down would escape into the earth. The effect would, therefore, be the same as if the individual were standing on the earth without the intervention of the non-conducting material. A descending bolt would be attracted towards his head, and if the tenacity of the beeswax were not sufficient to withstand a disruptive discharge, the body would be injured. It is

from a misapprehension of these principles that it has been supposed that the protection is increased by a slight covering over the body, of silk or feathers, or by interposing a plate of glass between the sky and body; but it is well known that fowls and other large birds are struck, the slight covering of feathers affording no protection while the feet are in connection with the earth.

From the conducting capacity of the lining of the soot of a chimney, and of the smoke and heated air which ascends from the flue, it will be clear that the vicinity of the fire-place during a thunder storm is not the safest position which may be chosen in a house. A person leaning out of an open window may also not be in a very safe position, because the outside of the house, wetted with rain, will be rendered a partial conductor, and a descending charge along the wall may reach the body projecting beyond the surface. The induction is always greater where there is a large amount of conducting material; hence barns filled with damp hay will be more liable to be struck than when empty. Besides the action of induction in this case, it is generally supposed that the danger is increased by the ascent of moist vapor from the barn at the season mentioned; and this supposition, which is in accordance with scientific principles, is apparently borne out by observation.

On the principle of the increase of induction in the collection of a large number of conducting bodies in a given space, the assemblage of persons in churches, or other places of public meetings, increases the tendency of lightning to fall on the edifice. The inductive action will be slightly increased when the audience assumes a standing position. For a similar reason, sheep which are crowded together during a storm are frequently killed by lightning. The fact has several times been noticed, that when a discharge passes through a number of animals arranged in a straight line, those which are at the extremities of the row suffer most; and this has been observed even when the animals were not in immediate contact with each other, as, for example, a number of horses in a series of stalls. It is probable that the heated air between the horses may have served as a conducting medium, and that the effect can be referred to the increase of intensity which always takes place in the electrical discharge at the points where the air is ruptured, or where the electricity enters and passes out.

The probability of injury from lightning, even in this country, where thunder-storms are comparatively frequent in the summer, is slight; and though it may be well to observe proper precaution, yet, on account of the small risk to which we are subjected, we should not deprive ourselves of the gratification of observing and studying one of the most sublime spectacles of nature; and, indeed, we know of no better way of overcoming the natural dread which many persons have of this meteorological phenomenon than by becoming interested in its scientific principles, and in studying, in connection with these, its appearance and effects.

EFFECTS OF THE INTRODUCTION OF GAS AND WATER PIPES.

Since the use of gas has become so general in our cities as to be considered almost one of the essentials of civilized life, a new source of danger has been introduced. Persons who repudiate the use of lightning rods, because they attract the electricity from the clouds, should reject the introduction of gas, particularly into the upper stories of their dwellings, since the perpendicular pipes must act as the most efficient conductors between the cloud and the earth. We say the most efficient, because they are connected below the ground with a plexus of pipes, in many cases, of miles in extent, the whole of which is rendered by the induction of a large cloud highly negative; and, since this action takes place with as much efficiency through the roof of a house and the chamber floors as it does through the open air, a gas-pipe, therefore, within a house, in proportion to its height, would powerfully attract any discharge from a cloud in its vicinity.

To obviate the danger from this source, the lightning-rod, which rises above the top of the building, should be placed in immediate metallic contact with the plexus of gas-pipe outside the house. If, as is very frequently the case, the rod is made to terminate by simple insertion of a few feet in the dry earth, while the gas-pipe is connected with miles of metallic masses, rendered highly negative by induction, the path of least resistance, or of most intense induction from the cloud to the earth, will be down the rod to some point opposite the gas-pipe, then through the house and down the pipe into the great receiver below. This conclusion, from the theory, is fully borne out by observation. On Friday evening, May 14, 1858, a house in Georgetown, D. C., was struck by lightning, and on Saturday, the next evening, another house was struck in Washington, on Seventeenth street, north of the avenue. The writer carefully examined the conditions and effects in both cases, and found them almost identically the same. The houses were similarly situated, with gable ends north and south, and attached to the west side of each was a smaller back building. The lightning-rod of the house at Georgetown was placed on the southern gable. It terminated above in a single point, and its lower part was inserted into hard ground, through a brick pavement, to the depth of about five feet. The lightning fell upon the point, which it melted, passed down the rod until it came to the level of the eaves, thence leaving the conductor, it passed horizontally along the wet clapboards to the southwest eave or corner of the house, thence down a tinned iron spout to the tin gutter under the roof of the back building, and thus it pierced the wall of the house opposite the point on the outside of the back building corresponding to the position of a gas-pipe in the interior, after which no further effects of it could be observed. A small portion of the charge, however, diverged to a second gas-pipe in an adjoining room. The back building was of wood, and the passage of the charge appeared to be facilitated by a large nail. The discharge was marked throughout its course by the effects it produced: 1st, the point of the rod was melted; 2d, a glass insulating cylinder, through which the upper part

of the rod passed, was broken in pieces; 3d, the horizontal clapboard extending from the rod to the eave was splintered; 4th, the tin of the gutters and spout exhibited signs of fusion; 5th, the plaster was broken around the hole through which the charge entered the house.

The lightning rod of the house which was struck in Washington was placed on the north gable; the electricity left the conductor at the apex of the roof, descended along the angle of the coping and the roof, which was lined with tin, to the northwest eave of the main building, thence southward along a tin gutter until it met a perpendicular tin spout, which conducted it to a point on the outside of the back building, corresponding to a gas-pipe within; it then pierced a nine-inch brick wall and struck the gas-pipe, which was embedded in the wall of the main building, at the distance of 15 inches horizontally north of the hole which it pierced in entering the interior. A lady was sitting with her back toward the point where the discharge entered the gas-pipe, at the distance of 18 inches, and, though she was somewhat stunned at the time, and perceived a ringing sensation in her ears for sometime after, she received no permanent injury. At the last meeting of the American Association, Professor Benjamin Silliman, jr., described two instances of a similar character, in which the discharge from the cloud struck twice, in different years, the lightning rod of the steeple of a church in New Haven, left the conductor and entered the building, to precipitate itself on the gas-pipes of the interior. The remarkable fact was stated, in connection with this occurrence, that the joinings of the gas-mains, under the street on the outside of the building, were loosened, apparently by the mechanical effect of the discharge, and the company was obliged to take them up and repair the damage, to prevent the loss of gas. An occurrence of this kind might, perhaps, lead the proprietors of gas-works to object to the proposition of connecting the end of the rod with these mains; but they should recollect that, if means be not furnished to prevent the danger consequent upon the use of gas, a less amount of the article will be consumed; and, furthermore, that giving more efficiency to the inductive action of the rod, on the cloud, by the connection we have proposed, the tendency to a discharge will be lessened; and, finally, that, if the connection be not formed, the discharge from the cloud will itself find the main through the gas-pipes within the house.

There is another source of danger, of a similar character, in cities supplied with water from an aqueduct; the pipes in different stories of the building, connected with the water-mains which underlie the city, are in most intimate connection with the earth, subject to a powerful induction from the cloud above, and therefore will attract any discharge which may be passing in their vicinity, or even determine the point at which the rupture of the stratum of air between the cloud and the house shall take place. In this case the lightning-rod should also be connected on the outside of the building with the pipes under ground, in order that the induction through the rod should be as perfect as possible, and that the consequent attraction may confine the charge, and transmit it entirely to the large mains, and from them to the earth. Houses are sometimes supplied with water from the roof, collected in tanks in the loft, whence it is distributed by pipes to different parts of

the building. This arrangement also tends to invite the lightning in proportion to the perpendicular elevation of this system of conductors. The lower ends of these are not usually in very intimate connection with the earth, and therefore a less powerful induction takes place than in the other instances we have mentioned. They should be placed, however, as in the preceding case, in good metallic connection, on the outside of the house, with the lightning-rod. The same remark applies to steam and hot-water pipes used for heating large buildings.

The different sides of a building are not all equally exposed to accident from lightning. Thunder clouds in this latitude approach us from the southwest, and hence the part of the house which faces this direction is not only more exposed to the fury of the storm, but also to the effects of the electrical discharge. The position, then, of the lightning-rod on this account is not to be neglected. The soot which lines a chimney is a good conductor, and hence the discharge not unfrequently passes into the house along the interior surface of this opening. But there is another circumstance which renders the chimney still more liable to be struck, namely: the column of heated air and smoke which ascends from it into the atmosphere when there is a fire burning below. These are tolerably good conductors of electricity, and as they may, under some conditions, extend to a considerable height in the atmosphere, they are sufficient to attract the descending discharge and determine its course to the chimney. A rod should therefore be placed on every chimney through which a column of heated air ascends during the season of the occurrence of thunder storms.

Among the many novel propositions which have been favored by Congress, there was one a few years ago connected with results having a bearing on this subject. For the purpose of lighting the public grounds, an appropriation was made to erect a mast eighty feet in length on the top of the dome of the Capitol. This mast was surmounted by a lantern of about six feet in height and of corresponding diameter, containing a large number of gas-burners, and terminated above by a gilded copper ball of about a foot in diameter. After this gigantic apparatus had been erected in defiance of all the principles of architecture and illumination, the author of this report was called upon to give his opinion as to the effect of lightning upon it. The answer given was as follows: Since the simplest method of obtaining electricity from the atmosphere is to elevate a piece of burning tinder on the end of a fishing-rod, the apparatus placed on the dome of the Capitol is a collector of electricity on an immense scale, and therefore it will probably be struck by lightning. As if to verify this prediction, on the occurrence of the first thunder storm, the apparatus received a discharge from the cloud, which fused several holes in the upper part of the ball and indented the surface, but fortunately did no damage to the building. The apparatus was then removed, and the ball deposited in the museum of the Smithsonian Institution as an interesting illustration of the chemical and mechanical effects of a discharge of lightning.

EFFECTS OF TELEGRAPH WIRES.

In 1846 the Hon. S. D. Ingham, of Pennsylvania, requested the opinion of the American Philosophical Society as so whether security in regard to accidents from lightning is increased or lessened by the erection of telegraph wires, the poles of which are placed by the side of the roads along which persons with horses and carriages are constantly passing. The subject was referred to the author of the present article, from whose report in regard to it the following facts and deductions are given. The wires of a telegraph are liable to be struck by a direct charge from the clouds, and several instances of this kind have been observed. About the 20th of May, 1846, the lightning struck the elevated part of the wire, which is supported on a high mast where the wire crosses the Hackensac river. The fluid passed along the wire each way from the point which received the discharge for several miles, striking off at regular intervals down the supporting poles. At each point where the discharge took place along a pole, a number of sharp explosions were heard in succession, resembling the rapid reports of several rifles. During another storm the wire was struck in two places on the route between New York and Philadelphia. At one of these places twelve poles were struck, and at the other eight. In some instances the lightning has been seen coursing along the wire like a stream of light, and in one case it is described as exploding from the wire in several places, though there were no bodies in the vicinity to attract it from the conductor.

That the wires of the telegraph should be frequently struck is not surprising, when we consider the great length of the conductor, and consequently the many points along the surface of the earth through which it must pass, peculiarly liable to receive the discharge from the heavens. Besides this, from the great length of the conductor, its natural electricity, driven to the further end or ends of the wire, will be removed to a great distance from the point immediately under the cloud, and hence this will be rendered more intensely negative and its attractive power thereby highly increased. It is not, however, probable that the attraction, whatever may be its intensity, of so small a wire as that of the telegraph, can of itself produce an electrical discharge from the heavens, although, if the discharge were started from some other cause, such as the attraction of a large mass of conducting matter in the vicinity, the attraction of the wire might be sufficient to change the direction of the descending bolt and draw it, in whole or in part, to itself. It should also be recollected that, on account of the perfect conduction of the wire, a discharge on any one point of it must affect every other part of the connected line, although the whole may be several hundred miles in length. That the wire should give off a discharge to a number of poles in succession, is a fact that might have been anticipated, since the electricity would, by its self-repulsion, tend to send a portion of itself down the partial conducting pole, while the remaining part, attracted by the wire in advance of itself, rendered negative by induction, would continue its passage along the metal until it met another pole, when a new division of the

charge would take place, and so on. The several explosions in succession, heard at the same pole, is explained by the fact that the discharge from the cloud does not generally consist of a single wave of electricity, but of a number of discharges in the same path in rapid succession, so as in some cases to present the appearance of a continuous discharge of a very appreciable duration; and hence, the wire of a telegraph is capable of transmitting an immense quantity of the fluid thus distributed in time over a great length of the conductor.

From the foregoing, in regard to the direct discharge, we think the danger to be apprehended from the electricity leaving the wire and striking a person on the road is small. Electricity of sufficient intensity to strike a person at the distance of twenty feet from a perfectly insulated wire would in preference be conducted down the nearest pole. It will, however, in all cases, be most prudent to keep at a proper distance from the wire during the existence of a thunder-storm, or even at any time when the sound of thunder is heard in the distance.

In case of wires passing through cities and attached to houses, they should be provided at numerous points with electrical conductors to carry off the discharge to the earth. These consist of copper wires intimately connected with the earth by means of a plate of metal at the lower end, extending up the pole or side of the house, and terminating in a flat plate above, parallel to another plate of metal depending from the wire of the telegraph. The two plates are separated by a thin stratum of air, or some other non-conducting material, through which the intense discharge from the clouds will readily pass and be conducted to the earth, while the insulation of the wire for the purposes of the telegraph is unimpaired.

There are other electrical phenomena connected with the telegraph which, though frequently annoying to the operator, are not attended with the same degree of danger to his person. These are immediately referable to induction at a distance, and consist entirely in the disturbance of the natural electricity of the wire. Suppose a thunder cloud to be driven by the wind in such a direction as to cross, for example, at right angles, the middle of a long line of telegraph wire. During the whole time the cloud is approaching the point of its path directly above the wire, the repulsion of the redundant electricity of the former will constantly drive the natural electricity of the latter further and further along the line, so that, during the approach of the cloud, a continuous current will exist in each half of the line. When the center of action of the cloud arrives at the nearest point of the wire the current will cease for a moment, and as the repulsion gradually diminishes by the receding of the cloud, the natural electricity of the wire will return to its normal condition by a current opposite to that which was first manifested. Since the thunder clouds over the greater portion of the United States move from west to east, lines in a north and south direction are more liable to currents of this class, which may be denominated those of statical induction.

There is another class of currents which, although they continue but for an instant, are more intense than the preceding, giving rise to vivid sparks, and are due to the dynamic induction at a distance of a discharge from a cloud to a cloud, or from a cloud obliquely to the earth.

The greatest intensity is produced when the path of the lightning is parallel to the line of the telegraph, and, in this case, under favorable circumstances sparks and shocks may result from a discharge between two clouds at the distance of several miles. In these inductive actions there is no transfer of the electricity from the cloud to the wire, but simply the disturbance of the natural electricity of the conductor by the repulsive energy exerted at a distance. As we have said before, nothing screens this induction, for, like magnetism and gravitation, it acts freely through the roof of a house, the air, and all other non-conducting materials, as it probably would do through void space. A similar result is produced on the long lines of railway, and sparks have been observed at the joining of the rails not in perfect metallic connection, particularly at the turn-tables.

The electrical telegraph is sometimes disturbed by other influences. It is evident from what we have said in reference to elevated bodies, that if a line of wire extends over a high hill, the intensity of electricity will be greater at the high points than below, particularly during the occurrence of fogs; the wire will tend to absorb the electricity of the air, and transmit it from the higher to the lower portions; also during the fall of rain and snow on one portion of a long wire, while clear weather exists at another, there would be a current of electricity observed in the intermediate portion. During very warm weather a feeble current is observed at different periods of the day, which may be referred to thermo-electricity. It is well known that when one end of a long conductor is heated and the other cooled, a current of electricity will pass from the hotter to the colder extremity, and this will be continued as long as the difference of temperature exists. Extended lines in a north and south direction are most favorably situated for observing a current of this class. Currents of electricity have also been observed in connection with the appearance of the aurora borealis, of sufficient intensity to set fire to pieces of paper. But the consideration of these will be postponed for another article.

MEANS OF PROTECTING BUILDINGS.

Although there has been much written and said in disparagement of the admirable invention of our illustrious countryman, Franklin, yet an attentive consideration of all the facts, even independent of theory, fully establishes its great importance.

1st. It is well known, from general experience, that lightning directs itself to the most elevated portions of edifices. Cotton Mather declares that lightning is under the immediate direction of the "Prince of the power of the air," because church steeples are more frequently struck than any other objects. It is therefore evident that the preservative means, whatever they may be, should be applied to the upper portions of a building.

2d. If other conditions be the same, lightning directs itself in preference to metals. When, therefore, a mass of metal occupies the more elevated portion of a house, we may be nearly certain that lightning, if it falls upon the building, will strike that point.

3d. Lightning, when it enters a metallic mass, does mischief only

when it quits the metal, and in the vicinity of the point at which it issues. A house, therefore, entirely covered with metal, would be safe, provided this covering were intimately connected with the ground, or if the roof be covered with metal, and this is intimately connected with the ground by metallic conductors of sufficient size, the lightning which may fall on the metallic covering will descend to the ground, which itself is a good conductor, provided it is saturated with water. When there are upon the roof, or in any of the upper stories of an edifice, several distinct metallic masses, completely separated from each other, it will be difficult to tell which of them will be struck in preference. The safest practice is to unite all these masses by rods or bands of iron, copper, or other metal, so that each of them may be in metallic communication with a rod, which may transmit the lightning to the damp earth.

"We thus deduce, from facts established by observation alone, without borrowing anything from theory," says Arago, "a simple, uniform, and rational means of protecting buildings from the effects of lightning. But when we refer, in addition to these facts, to the precise principles or laws of electrical action, as deduced from cautious and refined experiments in the laboratory, we are enabled to give rules for the protection of buildings which, when properly observed, reduce almost to insignificance the danger to be apprehended from the ordinary occurrences connected with the terrific exhibitions of thunder-storms."

From what we have said in regard to the principles of induction, and also in reference to the fact of the negative condition of the earth, it will readily be perceived that the upper end of an elevated conductor must become highly negative under the repulsive energy of a positive cloud, and though it may not be sufficient in itself to cause a rupture of the thick stratum of air intervening between the cloud and the earth, yet if a discharge does take place within the vicinity of this body, it will be drawn toward it, and if the conductor extends to the earth, and is in intimate connection with the damp ground, the discharge will pass innoxiously into the great reservoir. We further know, from theory as well as experiment and observation, that the intensity of attraction is increased when the conductor is terminated above in a single sharp point. Although the attraction at a distance may be greater on a metallic globe of a few feet in diameter than on a metallic point, since the former is able to receive a greater amount of induced charge, which, by the well known law of attraction, will act as if the whole were concentrated at the center of the sphere, yet the intensity of action of the point, and its tendency to open a passage through the air is so great, that it is preferred in protecting a given circumscribed space from lightning.

The question has been agitated, whether one point or a number on the same stem are to be preferred? But this question may be readily settled, provided the reason for preferring a point to a ball or a globe is legitimate, since the surface of a ball itself may be considered as made up of an infinite number of points, and therefore a number of points close together must react upon each other, and thus approximate in result the effect of a continuous spherical surface. In the case of three

points on the same stem, the whole amount of inductive effect which is produced in the rod is, as it were, divided into three parts, and is, therefore, less concentrated than in the case of one point; and although at a distance the effect of the three may be equally energetic, yet the one point tends more effectually to rupture the air, and open, as it were, a passage for the discharge from the cloud.

In reference to the subject of the termination of rods by balls or points, much discussion took place in the early introduction of the invention of Franklin, and the subject was elucidated by a very ingenious experiment made by Beccaria, in 1763, which is quoted by Arago. On the roof of a church at Turin this eminent electrician erected a rod of iron insulated on one of the flying buttresses. The upper part of this rod, which was terminated by a single metallic point, was hinged a few inches below the top, so that merely by pulling a string the point could be directed horizontally, upwards or downwards. When the point was pulled downwards during the presence of a thunder cloud in the zenith, the lower end of the rod gave no sparks; but when the point was suddenly directed upward, in a few moments sparks appeared. When the point was downwards, the rod presented a blunt termination toward the sky; when upwards, a sharp point. It might be well to repeat this experiment with some slight variation in the apparatus, in order to establish or disprove, by direct observation, the inference from theory that a single point acts more energetically than three or four points, terminating the same rod. The substance which terminates the conductor should be such as to preserve its form when subjected to the action of the weather, and be infusible by a stroke of lightning. The first requisite is found in the tip of an iron rod gilded, to prevent its becoming blunted by rust; but a point of this kind, though it may protect a building from the first discharge which strikes it, will be melted, and the intensity of its action thereby diminished in the case of a subsequent explosion. We now usually employ for terminating the lightning-rod, a small cone of platinum attached to a copper socket which fits on the top of the rod, made conical for that purpose. Tips of this kind are now generally offered for sale in the large cities. The quantity of platinum on them, however, is generally too small, since we have known them in several instances to be fused by a discharge of lightning. The point itself should be the apex of a solid cone of platinum, or of a thick plate of that metal, fastened by screwing or soldering to the copper socket.

We frequently see announcements in the papers of great improvements in lightning-rods, for which patents have been obtained, and among these boasted improvements have been the application of magnetized steel points to receive the lightning; but this invention, like most of the others which have been given to the public for the same purpose, is the result of some vague analogy or sheer charlatanism. It rests upon no foundation of observation, experiment, or theory. The magnetization of a bar, so far as it has any effect, tends to cause the electrical discharge to revolve around it, and to render the iron very slightly, if anything, a less perfect conductor.

The distance from a rod measured horizontally to which the protect-

ing influence extends, is a question of considerable importance. It has generally been admitted that the point of a lightning-conductor protects a horizontal circular space with a radius equal to twice its own height; that is, if the elevation of a rod above a flat roof be ten feet, it will protect a circular space of twenty feet radius, or forty feet diameter. But this rule cannot always be depended upon; for although it may be true in regard to buildings of stone or brick, with an ordinary sloping roof covered with tiles or slate, it would scarcely hold good if considerable masses of metal formed part of the building or the roof. Observations have been recorded of parts of houses being struck within the limit we have mentioned as that of protection; but there are scarcely any of them satisfactory in determining the point, since it appears from the evidence that in several cases there were separate masses of metal which formed, as it were, independent conductors, and in the other cases there was no evidence that the rod was in proper connection with the earth. In order to protect an extensive building, it will evidently be necessary to arm it with several lightning-conductors, and the less their height, the more they must be multiplied.

In the case of a high steeple, it may be well to establish points at different elevations, by branches from the main rod; for if it be true that the rod merely attracts the lightning which has been determined by the earth itself, or some material under the ground, the discharge, in its passage along the line of least resistance to the point at which it was aimed, may not be made to deviate from its direct course by the attraction of the distant elevated point, and will strike a lower portion of the building. Suppose, for example, a thunder cloud is on the west side of a high steeple, and the point of attraction, which may be damp earth, a pool of water, or other conducting material on the surface or under the ground, at the east end of the church. The discharge from the cloud, in its passage to the point of attraction, may strike a lower portion of the building, the action of the elevated point not being sufficient to deflect it from its course. This inference is in accordance with actual observation. Mr. Alexander Small wrote to Franklin from London, in 1764, that he had seen, in front of his window, a very vivid and slender lightning discharge moving low down, without a zig-zag appearance, and strike a steeple below its summit.

It becomes a matter of interest to ascertain whether the action of an assemblage of conductors, such as is usually found in cities, produces any sensible effect in diminishing the electrical intensity of the cloud, or, in other words, whether their united influence produces any sensible diminution of the destructive effects of thunder storms. Late researches have shown that comparatively but a small amount of development of electricity is sufficient to produce great mechanical effects. Faraday has even asserted that the quantity of electricity necessary to decompose a single grain of water, and consequently the electricity which would be evolved by the decomposition of the same element, would be sufficient to charge a thunder cloud, provided the fluid existed in the free state in which it is found at the surface of charged conductors. A similar inference may be drawn from the great amount of electricity developed by the friction of the small quantity of water existing in steam, as the latter issues through an orifice con-

nected with the side of the boiler. We also find that an iron rod of three fourths of an inch in diameter, is of sufficient size to transmit to the earth without any danger to surrounding objects, a discharge from the clouds, which may be attended with a deafening explosion, and with a jar of thunder powerful enough to shake the building to its foundation.

The intrepid physicist, De Raumer sent a kite up into the air to the height of 400 or 500 feet, in the cord of which was inserted a fine wire of metal. During a thunder storm, he drew from the lower extremity of the cord not mere sparks, but discharges of nine or ten feet long and an inch broad. Beccaria erected a lightning-rod which was separated in the middle by an opening, the upper part being entirely insulated. During thunder storms intense discharges darted incessantly through the opening. So constant were these, that neither the eye nor the ear was hardly able to perceive the intermission.

No physicist, says Arago, will contradict me when I say that each spark taken singly, would have given a shock attended with pain, that ten sparks would have numbed a man's arm, and a hundred proved fatal. Now a hundred sparks passed in less than ten seconds, and hence in every ten seconds, there was drawn from the cloud, a quantity of fulminating matter sufficient to kill a man, and six times as much in every minute. Arago calculates in this way that all the lightning conductors of the building in which the experiment was tried, took from the clouds as much lightning as would have been sufficient in the short space of an hour, to kill upwards of three thousand men. From the foregoing facts and conclusions, we may infer that the lightning-rods of a city may have some effect in silently discharging the cloud, and in preventing explosions which would otherwise take place; but we must recollect that on account of the upward rushing of the moist air, the electricity of the cloud is constantly renewed.

We cannot suppose that the sparks observed by Beccaria in his experiment, and the ringing of bells by Franklin, were due entirely to the electricity immediately received from the cloud. By the powerful induction of the redundant electricity of the latter and the negative action of the earth beneath, the natural electricity of the top of the rod, would be forced down into the earth, the point would become intensely negative, and in this condition would draw from the air around streams of electricity, and in this way a large volume of air around the top of the rod would become negatively electrified; and in case a discharge of lightning took place, its first effect would be to neutralize or fill up, as it were, this void of electricity in this large mass of air surrounding and above the top of the rod, before the remainder of the discharge could pass to the earth. The peculiar sound which is heard when a discharge from a thunder cloud is transmitted through a lightning-rod may possibly be attributed to this cause.

The Smithsonian building, situated in the middle of a plain, at a distance from all other edifices, with its high towers, is particularly exposed to discharges of lightning, and we have reason to believe that in as many as four instances within the last ten years, the lightning has fallen upon the rods and been transmitted innoxiously to the ground.

In two of the instances the lightning was seen to strike the rod on one of the towers; in a third, a bright spark due to induction and attended with an explosion as loud as that of a pistol was perceived; and in the fourth instance, although the platinum top of the rod, which was one hundred and fifty feet from the surface of the ground, was melted, the discharge was transmitted to the earth without any other effort than a slight inductive shock given to a number of persons standing at the foot of the tower. In three of the cases, the peculiar sound we have mentioned was observed; first, a slight hissing noise, and afterwards the loud explosion, as if the former were produced by the effect of the discharge on the air in the immediate vicinity of the rod, and the loud noise from that on the air at a more distant point of its path.

The writer of this article was led to reflect upon this effect of the rod, by a remarkable exhibition he witnessed during a thunder storm at night in 1856. He was in his office, which is in the second story of the main tower of the Smithsonian edifice, when a noise above, as if one of the windows of the tower had been blown in, attracted his attention; an assistant, who was present, was requested to take his lantern and ascertain what had happened. After an absence of some time he returned, saying he could discover nothing to account for the noise, but that he had heard a remarkable hissing sound. The writer then ascended to the top of the tower, and stood in the open trap-door with his head projecting above the flat roof within about twelve feet of the point of the lightning-rod. No rain was falling, though an intensely black cloud was immediately overhead and apparently at a small elevation; from different parts of this lightning was continually flashing, indeed the air around the top of the tower itself appeared to be luminous. But the most remarkable appearance was a stream of light three or four feet long issuing with a loud hissing noise from the top of the lightning-rod. It varied in intensity with each flash, and was almost continuous during the observation. Although the whole appearance was highly interesting, and produced a considerable degree of excitement, yet the writer did not deem it prudent to expose himself to the direct or even inductive effect of a discharge under such conditions, thinking, as he did, with Arago, that however our vanity might prompt us to boast of the acquaintance of some great lords of creation, it is not always desirable to seek their presence or court much familiarity with them. The effect in this case of the rod on the surrounding air and on the cloud itself by invisible induction must have been considerable.

ACTION OF LIGHTNING-RODS.

The question as to whether the lightning-rod actually attracts the electricity from a distance has been frequently discussed. It will be found, says Sir W. Snow Harris, "that the action of a pointed conductor is purely passive. It is rather the patient than the agent; and such conductors can no more be said to attract or invite a discharge of lightning than a water-course can be said to attract the water which flows through it at the time of heavy rain." This statement does not, as it appears to us present a proper view of the case. From the

established principles of induction, it must be evident that all things being equal, a pointed rod, though elevated but a few feet above the ground, would be struck in preference to any point on the surface, and the propositions as to the space which can be protected from a discharge of lightning is founded on the supposition that the direction of the discharge can be changed by the action of the rod at a distance, and the bolt drawn to itself. The true state of the case appears to us to be as follows:

1st. An elevated pointed rod, erected for example on a high steeple, by its powerful induction diminishes the intensity of the lower part of the cloud, and therefore may lessen the number of explosive discharges to the earth.

2d. If an explosive discharge takes place from the cloud due to any cause whatever, it will be attracted from a given distance around to the rod, and transmitted innoxiously to the earth.

A too exclusive attention to either one or other of these actions has led to imperfect views as regards the office of the lightning-rod. On the one hand, some have considered the whole effect of the rod is to lessen the number of discharges in the way we have described, and have considered it impossible that an explosive discharge could take place on a pointed conductor. But this is not the case, as was shown by Mr. Wilson many years ago by his experiments in London. It is true, that when a needle is presented to a charged conductor, the electricity is drawn off silently without an explosion, and this is always the case if sufficient time be allowed for the electricity to escape in this way. But if the point be suddenly brought within striking distance of the conductor by a rapid motion, such as would be produced by the movement of a horizontal arm carrying the point immediately under the conductor in an instant, an explosive discharge will take place. In this case, sufficient time is not given for the slower transmission of the electricity by what has been denominated the glowing discharge, and a rupture of the air is produced as in the action of a conductor terminated by a ball.

It would follow from this, that, in case of a rapidly-moving cloud across the zenith of a rod, there would be a greater tendency to an explosive discharge on the point than when the cloud was nearly stationary. For a similar reason, if a point, connected by a wire with the earth, be directed toward an insulated conductor, and the latter be suddenly electrified by a discharge from a second conductor, an explosion will take place between the first conductor and the point. A similar effect would be produced if a lower cloud received a sudden discharge from one above it, a case which probably frequently occurs in nature. Mr. Wise informs us that, when a discharge takes place beneath a cloud to the earth, a discharge is seen to pass between the upper and lower part of the cloud, represented by Fig. 19. We are warranted from the foregoing facts, as well as from the numerous examples in which lightning has actually beeen seen to fall upon pointed rods explosively, and the number of points which have been melted, to conclude that the rod, under certain conditions, does actually attract the lightning, though when properly constructed it transmits it without accident to the earth.

It has been denied by some that the point has any perceptible influence in lessening the number of strokes from a cloud, but this proposition can scarcely be doubted when we reflect upon the fact that it is not necessary entirely to discharge a cloud in order to prevent a rupture of the air, it being only necessary to draw off a quantity of the fluid sufficient to reduce it just below that which is required to produce the explosion; and for this effect there may be required but a very slight diminution in the intensity of a cloud which is just at the striking distance to prevent an explosion, particularly when we consider the prodigious number of sparks which, during thunder storms, were silently withdrawn from the cloud by the pointed rod erected by Beccaria.

Arago has collected a large number of instances, from which it appears that the erection of a rod lessened the number of explosive discharges.

The campanile of St. Marks, at Venice, which from the multitude of the pieces of iron in its construction, was in a high degree obnoxious to danger from lightning, and had been in fact prior to 1776, known to be struck nine times. In the beginning of that year a conductor was placed upon it, and since that time the edifice has been uninjured by lightning.

Previous to 1777, the tower of Sienna was frequently struck, and on every occasion much injured. In that year, it was provided with a conductor, and has since received one discharge, but with no damage.

In the case of a church at Corinthia, on an average four or five strokes of lightning annually were discharged upon the steeple until a conductor was erected, after which one stroke was received in five years. At the Valentino palace the lightning conductors established by Beccaria, caused the entire disappearance of strokes of lightning which were previously of frequent occurrence.

The monument in London, although only accidentally provided with a virtual conductor, appears to have been exempt from damage by lightning for nearly one hundred and eighty years.

The action of the rod, however, in diminishing the intensity of the cloud, can only be of a very temporary character, and cannot, as some have supposed, affect its subsequent state, or disarm it of its fulminating power, since its electricity is constantly renewed; a fact sufficiently demonstrated by the observation that a thunder storm, through its whole course of several hundred miles in extent, continually gives discharges to the earth. Notwithstanding the instances given by Arago of the diminution of discharges of lightning after the erection of the rod, the fact is established by observation, experiment, and theory, that the rod does attract the lightning, and receives the discharge not alone silently, but explosively. The points of the conductors are frequently melted, and although in cases in which this occurs, the discharge passes harmlessly to the earth, yet in some instance the explosion might not have taken place had the rod not been present.

In a house properly provided with lightning-rods, however many discharges may fall upon it, we are well assured from full experience and established principles, no damage can ensue to the occupants within.

There is, perhaps, no edifice in the country more exposed to explosive discharges of lightning than the Smithsonian building. It is situated on a plain, at a considerable distance from any other building, at present without trees near it, except those of a few years growth, and surmounted with nine towers, of heights varying from 60 to 150 feet. Five of these are provided with lightning-rods; and, although we should have advised the furnishing a rod to each tower, yet thus far the building has escaped unscathed, although several explosive discharges have passed down the rods.

The following instructive illustration of the action of a very elevated conductor in transmitting a discharge from a thunder cloud, is furnished us by Mr. Henry J. Rogers, telegraph engineer, who was himself an eye witness of what he relates:

"In accordance with my promise, I will endeavor to give you a brief description of the effect produced by atmospheric electricity at the House Telegraph Mast, erected at the palisades on the west side of the Hudson river, in the vicinity of Fort Lee, New Jersey, and distant about ten miles from the city hall, New York, during a terrific thunder storm which occurred on Friday, June 17, 1853, between three and four o'clock, p. m., while I was on an official visit.

"Before I proceed with the description, it will be necessary to explain that the wires of the House and Morse telegraph lines cross the Hudson river between Fort Washington and the palisades, inasmuch as this is the narrowest part of the river in the vicinity of New York; and the elevation of the land at the palisades, renders it a desirable place for suspending the wires from one shore to the other, so as to allow vessels of large size to pass under them free from interruption.

"The mast to support the wire was 266 feet in length, and was erected on the top of the columnar wall of the palisades, which at this place is 298 feet above the river, as determined by trigonometrical measurement. The top of the mast was therefore 564 feet above the water, and was sufficiently elevated to allow for the unavoidable swag of the telegraph wire, and to leave sufficient distance for vessels to pass beneath.

"It was composed of three pieces of heavy timber placed one above the other and fastened together by iron bands, to which were attached long iron braces or guys, secured at the lower ends to the rock, for the purpose of sustaining the mast in its perpendicular position. The braces or guys were formed of iron rods three fourths of an inch in diameter, and painted black. The longer or outer ones, those which were attached to the top of the mast along which the electricity descended to the earth, terminated about 32 paces from the lower end of the mast, and was composed of pieces of iron rod of thirteen feet in length, and each piece terminated in a bolt and shackle, thereby forming a series of links 30 in number.

"A lightning-rod six feet long, three quarters of an inch diameter, painted white, sharpened to a point, but not tipped with platinum, and secured at its lower end to the iron band to which were attached the upper set of guys, projected about two or three feet above the truck of the mast. The point of the rod was at the time in the center of a cedar bush in

full foliage which had been placed there by the riggers when they completed the mast.

"At 3 p. m., when the storm commenced, I placed myself in the railway house at Fort Washington, a point distant about three quarters of a mile from the mast at Fort Lee, on the opposite side of the river. From my position I could distinctly observe the gust as it advanced from the southwest; and from the heat of the weather and appearance of the clouds I expected to witness heavy discharges of atmospheric electricity, and prepared my mind to observe the effects of the storm on the mast at Fort Lee, having frequently expressed a desire to witness a thunder storm in the vicinity of the mast, as I felt assured the iron rod and guys would protect it from injury.

"As the gale increased, the clouds advanced with a heavy atmosphere, and accompanied with frequent discharges of lightning and loud thunder. When it approached the mast the foremost cloud assumed the shape of an inverted cone similar to those I have witnessed in the gulf, forming a water-spout; and I soon observed a terrific flash of lightning descend by the southern iron guy clearly defining its form and every link of the guy as though it were a rod of red-hot iron; and this appearance continued for a least four seconds, followed by three or four heavy peals of thunder in rapid succession, during which time the lightning appeared to flow in a continued stream of fire along the iron guy, and giving off during its progress apparently as many snaps of electricity as there were links in the guy, and which I supposed to be caused by the resistance offered by each link to the free passage of the electricity.

"These discharges were succeeded by a heavy gush of rain, which obstructed my view of the palisades, but other discharges of atmospheric electrity followed as the cloud rushed on its course of the North river. The storm lasted about half an hour.

"Within 50 paces north of the mast described stood the Morse-line mast, which is about 40 feet less in height than the House mast; and during the storm there was no indication of any part of it being struck by lightning, although there is attached to it a conductor of atmospheric electricity. From this, I infer that the discharge of lightning passed to the earth along the iron guys of the House mast, owing to its greater elevation, and its being nearer south in the direction of the storm.

"Such was the vividness and intensity of the light which was emitted along the guy at the time of the discharge that I received the impression that the iron was melted, and expected every moment to see the mast prostrated by the wind, but was much surprised, on examining the premises next day, not to find the least evidence of fusion on the rod, or marks of any kind along its surface, to indicate the passage of the electrical discharge.

"The palisades in the vicinity of the mast are heavily timbered, and although the limbs of several trees are in contact with the iron guys running from the mast, not the slightest damage was done to any of these trees; but about one fourth of a mile south of the mast a large tree was shattered by lightning during the same storm.

"The mast stood about five years, and during that time, as reported

by those having charge of it, was struck at almost every violent thunder storm that passed over the place. It was considered by persons living in the neighborhood as a protection against lightning.

"Indeed such was the confidence in it, that the telegraph workmen did not hesitate to take shelter during a storm in a house 15 feet square, which was built around the mast, and in which implements, windlasses, &c., were kept.

"HENRY J. ROGERS.

"BALTIMORE, *November* 30, 1853."

The facts presented in the foregoing narative are highly instructive. The descent of the visible vapor in the form of an inverted cone is a phenomenon which will be considered of special interest, particularly by those who ascribe the motive power of a tornado entirely to electricity.

The continuance of the discharge during four seconds is in accordance with other instances which have been frequently observed, and is to be attributed to a series of discharges in rapid succession through the same path.

The appearance of light along the whole course of the rods forming the guy may be attributed to the circumstance that the metal at the time of the discharge was covered with a thin stratum of water into which the electricity was projected by its self-propulsion, and on account of the imperfect conductibility of the liquid, gave rise to the phenomena observed.

This may be illustrated experimentally by discharging an electrical battery through a slip of tin foil wetted with a thin stratum of water. The discharge which would be insensible along the dry metal becomes luminous through its whole course.

While this account of Mr. Rogers clearly shows the attractive power of an elevated conductor under particular circumstances, it also proves the fact that an edifice may be protected from harm, provided it be furnished with a sufficient number of properly constructed rods.

CONSTRUCTION OF LIGHTNING-RODS.

Electricity as we have seen page 483, tends to pass at the surface of a conductor of a sufficient size, but it does not follow from this that every increase of surface, the quantity of metal being the same, will tend to diminish the resistance of the conductor to the passage of a discharge. From an imperfect view of the subject, many persons have supposed that merely flattening the lightning-rod, and thus increasing the surface would tend to increase the conducting power, but it must be evident from the principle of repulsion, that in diminishing the distance between the two flat surfaces, we tend to increase the repulsion between the atoms, which would pass parallel to the axis along the middle of each flat side, and thus, though the surface is increased by flattening a round bar, the conduction is diminished, and a greater intensity is given to the electricity at the edges, tending to increase the lateral escape of the fluid. The only proper way of diminishing the resistance to conduction in a cylinder of metal of a given capacity, is

to mold it into the form of a hollow cylinder; a gas-pipe, for example, will offer less resistance to conduction than the same weight of metal in the form of a solid cylinder; but we must not infer from this that a gas-pipe an inch in diameter will conduct better than a solid rod of iron of the same diameter. There is no known law of electricity which would lead us to suppose that by removing the metal from the interior of a rod, we increase its conducting capacity. On the contrary, when the charge is very great in proportion to the size of the conductor, it is probable that the discharge penetrates through the entire mass. The rod should be of sufficicent size to transmit freely the largest discharge which experience has shown to fall on a building. A rod of three fourths of an inch of round iron is generally considered sufficient for this purpose, since a conductor of this capacity has in no case been found to have been fused by a discharge from the clouds. There is no objection on the score of electrical action to using a larger bar, or to the same weight of metal in the form of a hollow cylinder; indeed every increase of diameter lessens the resistance to conduction, and the tendency to give off lateral sparks.

Lightning-conductors are frequently constructed in this country with points projecting at intervals of two or three feet through their whole length; this plan has been adopted from some erroneous idea in regard to the action of the conductor, and of the proper application of points. The essential office of the conductor is to receive the discharge from the cloud, and to transmit it with the least resistance possible, silently and innoxiously to the great body of the earth below, and anything which militates against these requisites must be prejudicial. Now, in the passage of the electricity through a conductor, it retains its repulsive energy, and hence each point along the rod in succession becomes highly charged, and tends to give off a spark to bodies in the neighborhood. Besides this, the irregularity in the motion of the electricity which is thus produced, must on mechanical principles interfere with its free transmission. The points along the course of the rod should, therefore, be omitted, since they can do no possible good, and may produce injury.

We may conclude what we have said in regard to lightning-rods by the following summary of directions for constructing and erecting them:

1st. The rod should consist of round iron, of not less than three fourths of an inch in diameter. A larger size is preferable to a smaller one. Iron is preferred because it can be readily procured, is cheap, a sufficiently good conductor, and when of the size mentioned cannot be melted by a discharge from the clouds.

2d. It should be, through its whole length, in perfect metallic continuity; as many pieces should be joined together by welding, as practicable, and when other joinings are unavoidable, they should be made by screwing the parts firmly together by a coupling ferule, care being taken to make the upper connection of the latter with the rod water-tight, by cement, solder, or paint.

3d. To secure it from rust, the rod should be covered with a coating of black paint.

4th. It should be terminated above, with a single point, the cone of

which should not be too acute, and to preserve it from the weather as well as to prevent melting, it should be encased with platinum, formed by soldering a plate of this metal, not less than a twentieth of an inch in thickness, into the form of a hollow cone. Usually the cone of platinum, for convenience, is first attached to a brass socket, which is secured on the top of the rod, and to this plan there is no objection. The platinum casing, however, is frequently made so thin and the cone so slender, in order to save metal, that the point is melted by a powerful discharge.

5th. The shorter and more direct the rod is in its course to the earth the better. Acute angles made by bending in the rod and projecting points from it along its course should be avoided.

6th. It should be fastened to the house by iron eyes, and may be insulated by cylinders of glass. We do not think the latter, however, of much importance, since they soon become wet by water, and in case of a heavy discharge are burst asunder.

7th. The rod should be connected with the earth in the most perfect manner possible, and in cities nothing is better for this purpose than to unite it in good metallic contact with the gas mains or large water pipes in the streets; and such a connection is absolutely necessary if the gas or water pipes are in use within the house. This connection can be made by soldering to the end of the rod a strip of copper, which, after being wrapped several times around the pipe, is permanently attached to it. Where a connection with the ground cannot be formed in this way, the rod should terminate, if possible, in a well always containing water, and where this arrangement is not practicable, it should terminate in a plate of iron or some other metal buried in the moist ground. It should, before it descends to the earth, be bent so as to pass off nearly perpendicular to the side of the house, and be buried in a trench surrounded with powdered charcoal.

8th. The rod should be placed, in preference, on the west side of the house, in this latitude, and especially on the chimney from which a current of heated air ascends during the summer season.

9th. In case of a small house, a single rod may suffice, provided its point be sufficiently high above the roof, the rule being observed, that its elevation should be at least half of the distance to which its protection is expected to extend. It is safer, however, particularly in modern houses in which a large amount of iron enters into the construction, to make the distance between two rods less than this rule would indicate rather than more. Indeed we see no objection to an indefinite multiplication of rods to a house, provided they are all properly connected with the ground and with each other. A building entirely inclosed, as it were, in a case of iron rods so connected with the earth, would be safe from the direct action of the lightning.

10. When a house is covered by a metallic roof, the latter should be united, in good metallic connection, with the lightning-rods; and in this case the perpendicular pipes conveying the water from the gutters at the eaves may be made to act the part of rods by soldering strips of copper to the metal roof and pipes above, and connecting them with the earth by plates of metal united by similar strips of copper to their lower ends, or better with the gas or water-pipes of the city. In this

case, however, the chimneys would be unprotected, and copper lightning-rods soldered to the roof, and rising a few feet above the chimneys, would suffice to receive the discharge. We say soldered to the roof, because if the contact was not very perfect, a greater intensity of action would take place at this point, and the metal might be burnt through by the discharge, particularly if it were thin.

11. As a general rule, large masses of metal within the building, particularly those which have a perpendicular elevation, ought to be connected with the rod. The main portion of the great building erected for the world's exhibition at Paris is entirely surrounded by a rod of iron, from which rises at intervals a series of lightning conductors, the whole system being connected with the earth by means of four wells, one at each corner of the edifice.

The foregoing rules may serve as general guides for the erection of lightning-rods on ordinary buildings, but for the protection of a large complex structure, consisting of several parts, a special survey should be made, and the best form of protection devised which the peculiar circumstances of the case will admit.

Various patents have been obtained in this country for improved lightning-conductors, but as a general rule such improvements are of minor importance.

An improvement in the form of the lightning-rod, which was recommended by the French Academy in 1823, would presuppose some important discoveries in electricity having a bearing on the subject; but after the lapse of thirty years, the same Academy being called upon to consider the protection of the new additions to the Louvre, finds nothing material to change in the principles of the instructions at first given.

TOBACCO.

From Charles A. Leas, *United States Consul.*

Revel, Russia, *August* 25, 1859.

Tobacco is cultivated in the Russian governments of Paltowa, Tschernegow, Saratof, Bessarabia, Charkow, Orel, Riazen, Koursh, Kiew, &c,, portions of the Crimea, Siberia, and the Trans-Caucasian provinces. I understand, however, that in consequence of the failure to produce a good and profitable article, its cultivation has been abandoned in some of the above governments. It is all of very inferior quality. The only place that an article sufficiently good for the manufacture of cigars is produced, is in Bessarabia.

The government of Russia, with the view of encouraging and improving the cultivation and quality of tobacco, had seed brought from Turkey, Germany, Cuba, and the United States, and distributed it free; but still the experiments were not satisfactory. She then in-

structed her agents in those countries to observe carefully the cultivation and all the important facts connected therewith, and transmit the result for the benefit of the cultivator. An experienced tobacco grower was also brought from Germany to impart instruction. After all this, as above stated, an article sufficiently good for cigars could not be produced, except in Bessarabia, and that was from seed brought from the United States. Its cultivation has been proved to exhaust, to an enormous extent, the strength of the soil, to renew which the strongest manures must be used; namely, the ordinary barn-yard manures. It is not here as profitable a crop as the ordinary grains; that is to say, in some of the governments alluded to the cost of transporting the surplus grain product to the exterior is so great, that the cultivation of tobacco takes its place from necessity, because the tobacco can be consumed at home. But there is little doubt that when Russia shall have completed her great net-work of railroads, thus giving to her people a cheap and speedy outlet for the surplus grain product, tobacco will cease to be cultivated to any considerable extent, and the demand from foreign countries will be increased. There is none so popular in Russia as the American tobaccco, and that of Maryland is preferred.

At present about one hundred and eight millions of pounds is produced per annum. None, I believe, is exported.

In 1857, 60,000,000 of pounds was imported, namely:

	Poods.
From America, direct	422
From Prussia	14,601
From Denmark	384
From Hanse Towns	51,141
From Holland	44,544
From Belgium	16
From England, direct	3,148
From France, direct	636
From Sardinia, direct	1
From Austria, direct	154
From Turkey	56,458
From West Indies and South America	376
From all other countries	576
	172,457

or 30,000 English tons.

The duty on tobacco brought into this country, is, on raw or unmanufactured, six rubles and thirty kopecks per pood, or $308 57 cents per ton, being fifteen and nearly a half cents on the pound, or, as will be seen by the United States census returns, over 100 per cent. on the cost of production in America.

On smoking tobacco the duty is the same. On cigars it is about $1 50 per pound.

There is no tobacco made or used for the purpose of chewing in this country. Each inhabitant in the empire consumes an average of two pounds per annum.

The land produced an average of from 80 to 100 pounds to the acre. The price to the producer averaging from 1 to 37 kopecks per pound, or from three quarters of a cent to about 28 cents per pounds.

From B. HAMMATT NORTON, *United States Consul.*

PICTOU, NOVA SCOTIA, *July* 25, 1859.

Tobacco is not grown is this region of country. About 100,000 pounds of the leaf are imported yearly, which is manufactured and sold in this vicinity.

The chief articles of export from this province are coal, fish, and potatoes. Three fourths of the exportations are to the United States.

From DANIEL R. B. UPTON, *United States Consul at Bathurst.*

This is not a tobacco producing country, and, therefore, the only information I can furnish is as follows:

The amount of tobacco imported, according to the customs returns, for the year ending December 31, 1858, was 497,360 pounds, of which 251,980 were direct from the United States; 146,058 *via* Great Britain; 79,522 *via* France; and 19,800 by way of Gorée, a neighboring French port. The duties on tobacco imported, either in British or foreign bottoms, are four per cent. on invoice cost, and a half penny or about one cent per pound.

From S. J. MERRIT, *United States Consul at Nassau, Bahamas.*

What amount of tobacco is produced per annum I have no means of ascertaining, but it is very small, and for domestic use only. The quantity imported, in pounds, is as follows:

Cuba, 1,680, unmanufactured; United States, 89,040, *i. e.*, 60,928 manufactured, 28,112 unmanufactured; St. Domingo, 1,792, unmanufactured; British West Indian Islands, 1,792, manufactured; received from wrecked vessels, 15,232, manufactured; total 109,536 pounds. This is exclusive of the importations of cigars, which are as follows: From the Spanish Islands, 210,000; United States, 17,000; St. Domingo, 15,000; total 242,000. As to duties no distinction is made between British and foreign bottoms. There is no export duty. Import duties on manufactured, 14 shillings sterling per 112 pounds; unmanufactured 5 shillings sterling per 112 pounds; cigars, 4 shillings sterling per 1,000, and 15 per cent. *ad valorem.* I have no means of ascertaining the number of cigars made per annum, but it is small—probably about 500,000. They are very poor, and will average in value about $6 per 1,000. There is no other manufacture of tobacco. Some cigars are sold at $30 per 1,000. The average price is about $15. Very little

snuff is sold, and that at retail. A little over seven pounds of tobacco are consumed per annum by each male inhabitant.

From Robert Dowling, *United States Consul at Cork, Ireland.*

About 600 hogsheads of tobacco per annum, averaging 1,460 pounds each, or 876,000 pounds, are imported from the United States and Cuba, but none exported, except small quantities as ship stores, on which no duty is charged. The duties charged per pound on unmanufactured leaf are 3 shillings, (75 cents,) and on manufactured 9 shillings, ($2 25,) with 5 per cent. additional in each case. The price of cigars per 100 is about 18 shillings, duty paid, ($4 50;) that of tobacco prepared for smoking, per pound, 4 shillings sterling, and of snuff, per pound, 8 shillings sterling, ($2.) The smokers in this district are chiefly males, who consume, on an average, seventeen pounds of tobacco per annum, or three fourths of an ounce per day each.

From Stephen Ralli, *United States Vice-Consul at Odessa.*

There are no means of ascertaining what has been the ratio of increase or decrease in the amount of tobacco cultivated in South Russia since the last census, for accounts of this description are not kept in this country.

The government of Saratoff, in which this culture is the largest, produces about 1,800,000 or 2,000,000 pounds per annum. What the production may be in other governments cannot be determined.

The amount imported in Odessa, chiefly from Turkey, is about 2,000,000 pounds per annum, taking one year with the other. It is imported, also, in other ports of the Black and Azoff seas, but it is difficult to know the quantity, there being no publications in this country giving such or any similar information.

The government of Saratoff exports about 360,000 pounds, and sometimes as much as double that quantity per annum. From Odessa there is no export.

The import duties are—

For tobacco in leaves,	14	cents per pound,
" cut tobacco,	$55\frac{1}{2}$	" "
" cigars,	$1 85;	

Beside an excise duty, but which is not important.

The price of cigars made in Russia is $7 50 to $37 50 per thousand. That of foreign is $45 to $260 per thousand.

The price of the production of Saratoff is $3\frac{1}{7}$ cents to $4\frac{1}{5}$ cents per pound. Of other governments it is $8\frac{1}{10}$ cents to 35 cents per pound. The average price, however, of the latter may be put down at 16 cents per pound.

The highest price of Russian snuff—which is of a very common kind—is $5\frac{1}{4}$ cents per pound.

The best varieties of tobacco cultivated are Turkish, called Dubeck and Samsoun. The length of the leaves is 10½ inches, and the number of leaves to a plant 15 to 25. The yield, per acre, is about 650 to 1,300 pounds.

The latest frost in spring is in March, and the earliest in autumn in October; both old style.

The tobacco seed is obtained from Turkey, and the price is \$3 33⅓; from America, \$2; from Havanah, \$7 30; and from the Cape, \$3 75. It is sown in the month of March. No particular attention is paid to the soil, only the site for a seed-bed is selected where sheep have been pasturing. The soil is generally dug deep. The seed is sown on the surface, and covered over lightly. It vegetates in from fifteen to twenty days, according to the season.

No precautions are taken against accidents by frost or drought.

The most suitable size of plants for removing to the field is when they have four leaves.

The soil where sheep have been pasturing is best adapted to tobacco. Not particular about aspect—preference, however, is given to hilly places not exposed to the north. The ground is dug deep for planting. Sheep manure is used by letting sheep pasture where tobacco is to be planted. Their urine is also considered to be very good. Transplanting is performed in the month of June. Generally about thirteen hundred plants are allotted to the acre. They are put in rows, one foot two inches apart, and the space between the plants is seven inches. The crop requires, previous to "topping," no other culture than cleaning. The maturity of the leaves begins one month and a half after planting. If the season is very hot, the leaves dry in the course of eight days; but if the atmosphere is cool, in fifteen days. Generally they string as many leaves as they can, in order to place them on sticks of the length of 11 feet 8 inches. The tobacco is exposed only to the air passed through a string. No artificial heat is employed. It is sufficiently dried when the leaves break in the hand and can be reduced into powder. It is only dried in the open air and in the shade.

After collecting the crop, they proceed to strip the sticks of the leaves, to make bundlès of them. The sorting is of four kinds, and is packed as Turkish tobacco, in bundles of from one hundred to one hundred and fifty leaves each.

All the expenses for cultivating an acre of tobacco, ready to be offered for sale, amount to about \$40. The largest crop of an acre is about 1,300 pounds; the average about 900 pounds. Its greatest value per pound is about 37 cents. It is not cultivated for seed. Russian, of Bessarabia, is sold at \$1 60 per pound. The stalks are sold to the German colonists, who cut them for smoking.

Tobacco is an exhauster greater than any other crop. It is usually cultivated three years in succession on the same land. No attention is paid to rotation. It is attacked by grubs, for the ravages of which no preventives or remedies have been applied.

Land is measured in Russia by sagenes and deciatines. A deciatine contains 2,400 square sagenes; the acre contains 889 square sagenes. The sagen is 7 feet, English, consequently a deciatine is equal to 2.70

acres. An archine is divided into 16 vershoks, and is equal to 28 inches. The pood is equal to 36 pounds, English; the silver rouble is equal to 75⅕ cents. It is upon this basis that the foregoing calculations have been made.

Report of THOMAS SAVAGE, *United States Vice-Consul General.*

HAVANA, CUBA, *September* 22, 1859.

The celebrated tobacco of Cuba is produced in a certain portion of the western part, and is called *Vuelta abajo.* Throughout the eastern part of Cuba the tobacco raised is only sorted into three classes, and no effort is made to improve its quality, or even to put it up in a way to give it a fair appearance for the purpose of insuring a ready sale at remunerative prices. Many improvements have been introduced there: first, in the *wash* or *mixture* with which the leaf is sprinkled before packing; secondly, in the selection or sorting of the leaves into six classes; thirdly, in the manner of making and tying the manajos or hands; and finally, in the form of the bales and mode of placing the manajos in them. By means of this wash, the inferior leaf of the eastern part of Cuba, or *Vuelta arriba,* acquires strength, elasticity, and softness, (fit to twist into fair-looking cigars,) a better flavor, finer color and appearance, and increased aroma and fragrance; consequently it brings a much higher price in the market. It is well known that the tobacco raised in the district of Gibara, and brought to that port for embarkation, is about the most inferior article raised in the island that is ever brought to market. The price there is generally $8 to $10 per 100 pounds, in bales averaging 125 pounds; the same article, thus prepared and packed, has been obtained in Havana repeatedly, per bale, $51 for firsts and seconds, $40 for thirds, $34 for fourths, $25 to $30 for fifths, and $15 to $16 for sixths and sevenths, as seven classes have sometimes been sorted. In Matanzas, at a time when tobacco was dull, $25 50 were received for 100 pounds, assortment, and at another time $36.

From J. B. HAYNE, *United States Consul.*

TURK'S ISLAND, WEST INDIES, *August* 8, 1859.

Tobacco is not cultivated on this island or its dependencies. I have learned from the exports of the custom-house, that for the year 1858, three thousand eight hundred and sixty-five pounds of the leaf, costing about $2,920, were imported for home consumption, about half of this from the United States, and the rest from the West Indies.

Of the manufactured there were twelve thousand nine hundred and ninety-eight pounds, costing about $2,585, imported for the same purpose; this was mostly from England, and English ports in the West Indies.

The inhabitants here smoke and chew on about the same average

with the same number in the United States, with, perhaps, a degree of more moderation.

From SAMUEL W. TALBOT, *United States Consul.*

DUBLIN, IRELAND, *September* 1, 1859.

At one period the cultivation of tobacco had made considerable progress in Ireland, the soil and climate being very favorable to its growth; but about forty years ago its culture was totally prohibited by government, as it was found impossible to devise any plan for collecting the duty imposed upon it, and no advantages to Ireland could compensate for the sacrifice of the revenue, which yields five or six million of pounds sterling annually.

About four thousand hogsheads of tobacco are imported into Ireland, of which three thousand five hundred come from Virginia, and five hundred from Kentucky, none being imported from any other foreign country.

A duty of 3*s.* 2*d.* per pound is charged on the foreign import.

No cigars are manufactured, the four thousand hogsheads above named being made into twist and snuff.

Cigars are sold by the pound weight at wholesale, the foreign duty paid at 25*s.* per pound average, and the English-made sell at from 9*s.* to 15*s.* per pound.

The price per pound of tobacco prepared for chewing is 3*s.* 6*d.*; of that for smoking, 3*s.* 6*d.*; and of snuff, 5*s.* per pound.

It is impossible to answer how many pounds are consumed per annum, or even to make an approximation to the amount.

The value is 8*d.* per pound for leaf, in bond, and 10*d.* per pound for strips, in bond, the purchaser paying the duty.

Snuff is made of the stalks.

With regard to the importation of tobacco into Ireland, it should be very dry in condition, free from blister, a good substance, and of darkest color.

From HERBERT DAVY, *United States Consul.*

NEWCASTLE-ON-TYNE, ENGLAND,
August 24, 1859.

In 1858, 62,217,705 pounds were imported from North and South America, Germany, &c., namely: stemmed, 20,004,956; unstemmed, 39,638,824 pounds; manufactured and snuffs, 2,573,925 pounds.

In the same year, 10,504,236 pounds were exported, and to all countries except France.

The duties charged per pound on tobacco are 3*s.*, and five per cent. if cleared for home trade; if for export, no duty; on manufactured, 9*s.*

The price of cigars per thousand is 250*s.* per thousand, in bond; and as low as 60*s.*; while the greatest and average price per pound of tobacco

prepared for chewing, is 8*s*. 5*d*., 4*s*., and 3*s*. 4*d*.; that of tobacco prepared for smoking, 8*s*., 4*s*., and 3*s*. 4*d*.; and the highest of snuff per per pound, 2*s*., 5*s*., and 4*s*. the average.

The number of pounds of tobacco consumed per annum, on an average, by each male inhabitant of Great Britain, in 1853, was 19 ounces; in Ireland, 12 ounces, being one half greater in the former than in the latter.

The greatest and average value of pressed tobacco per pound, for cutting purposes, is about 6*s*. and 4*s*.

Snuff is made of the stalks.

The consumption, it will be perceived, is very great, and is undoubtedly increasing.

From R. S. Newbold, *Acting United States Consul.*

Port of Spain, Trinidad,
September 12, 1859.

This is not a tobacco growing island, there being but a very small quantity grown in one section of the country, and entirely for local consumption. The greater portion of the tobacco imported into this island is the production of the United States, and may be estimated at between 2,000,000 and 3,000,000 pounds per annum, of Kentucky leaf.

The duty on tobacco imported into this colony is as follows:

On unmanufactured, 9 cents per pound.
On chewing tobacco and snuff, 12 cents per pound.
On cigars, 18 cents per pound.

The actual number of hogsheads imported from the United States in 1858 was 203, which would give 3,000,000 pounds.

From John Black, *United States Commercial Agent.*

Galle, Ceylon, *September* 29, 1859.

The cultivation of tobacco is entirely in the hands of natives, for local consumption, with the exception of a small quantity, unmanufactured, exported to Stavancore.

Tobacco is cultivated chiefly at Jafnapatam, at the north end of the island. The coarser kinds appear to be best adapted to the soil.

A few years ago experiments were made at the south of the island, a few miles from Galle, by Europeans; the seeds used being from Cuba. This, however, proved a failure, and the work was abandoned.

I am unable to furnish even an estimate of the quantity cultivated, as no revenue is obtained from this article.

Cigars are imported from Manilla and China.

From W. H. Morse, *United States Consul at Cape de Verds.*

In this group of islands only about 5,000 pounds of tobacco are produced per annum. Sixty thousand pounds are imported, only from the United States. There is no exportation whatever. All tobacco pays eleven cents per pound on importation. No cigars are manufactured. Their greatest and average price per thousand is from $16 to $30; and of tobacco prepared for chewing, per pound, twenty cents. No snuff is imported into these islands. The native manufactured sells at sixty cents per pound. About one pound of tobacco is consumed per annum, on an average, by each of the male inhabitants. The variety grown here I cannot name. It receives no especial care. The leaves are short and few. The temperature is from 68° to 80°. Tobacco will grow any month during the year. It is generally cultivated in August, September, and October. The seed is obtained from America—the average cost being 12 cents per pound. It is generally sown down during the rains; but any time is proper where the soil can be irrigated. The site selected is near houses, and sheltered from the sun, in a rich soil. The ground is simply well hoed, as a preparation for planting. The greatest and average value per pound of the leaf is from 16 cents to 10 cents.

From G. H. Goundie, *United States Consul at Zurich, Switzerland.*

Switzerland produces very little tobacco. It is only raised in one of the 22 cantons, and there only in small quantities. I have for several years past supplied them with seed from the United States; but it appears that the tobacco which I introduced in the palatinate in 1846–47—now raised in all parts of Germany where tobacco is grown, and called by order of the government of the Grand Duchy of Baden "Goundie tobacco"—is greatly preferred here in Switzerland also. It brings from 4 to 10 florins more than any other kind.

From Henry Pemberton, *Consular Agent of the United States at Quebec, Canada.*

Only a little tobacco is grown here, for their own use, by the farmers. 220,000 pounds are imported (all from the United States) into Quebec, 3,340,000 pounds into the Canadas. A duty of 30 per cent. is charged. The greatest and average price of cigars per 1,000 is from $5 to $80.

The price of tobacco, by the pound, for chewing, varies from 10 cents to 40 cents; and the price of that prepared for smoking varies from 5 cents to 20 cents. The greatest and average price of snuff per pound is from 10 to 20 cents. Import very small. Small farmers sow the seed for their own use in May. The tobacco stalks are ground into snuff. A great deal of tobacco is grown in the most western parts of Canada West, but I am not aware that any returns of the quantities are kept. All the imported tobacco comes from the United States, and nearly all in a manufactured form.

From L. H. HATFIELD, *United States Consul at Bombay.*

The quantity of tobacco imported into Bombay amounts to 1,732,833 pounds per annum, and the countries from which it is imported are as follows:

United Kingdom, Aden, African coast, America, Arabian gulf, Cape of Good Hope, Ceylon, Hong-Kong, China, France, Manilla, Mauritius, Penang, Singapore, Persian Gulf, Suez, Madras, Malabar, Canara, Cutch, Goa, Damaun, Dieu, Calcutta, and Goojerath.

The quantity exported amounts to 315,733 pounds per annum, and the countries to which it is exported are as follows:

United Kingdom, Aden, Arabian Gulf, Hong Kong, Mauritius, Penang, Singapore, Persian Gulf, Malabar, Canara, African coast, Madagascar, Hamburg, Suez, Madras, Cutch, Goa, Damaun, and Dieu.

On the imports of tobacco from foreign ports, a duty of 20 per cent. is charged on its market value, and a further duty, at the rate of $7\frac{1}{2}$ rupees per Indian maund of 82.28 pounds, is levied when the same is taken into town for consumption. Export tobacco is free, as are also all its preparations.

The above remarks apply equally to tobacco imported in foreign or other bottoms.

The greatest and average price of cigars per 1,000 is as follows:

Brands.	Average price.	Greatest price.
	Rupees.	*Rupees.*
Havana	75	100
Manilla, No. 2	30	50
Trichinopoly, 1st sort	12	16
Trichinopoly, 2d sort	7	10
Calcutta	6	7

The price of country tobacco used for chewing varies from 5 to 6 annas per pound, while the American averages from 12 to 16.

The average price of country tobacco used for smoking is from 4 to

5 annas per pound, and its greatest price never exceeds 6. The price of the American varies from 12 to 16.

The price at which country snuff is generally sold varies from 8 to 16 annas per pound, according to quality, while Macoba and Musilipatam bring as much as 2 rupees per bottle, of 1½ pounds.

Independently of the different descriptions of tobacco imported from various countries, the best varieties of what is called the country tobacco, cultivated in the province of Gujeerath and over the Ghants, are mentioned below, in the order of their quality:

Melao, Jode, reddish-brown.
Vurtal, Merjee Ghatty, dark-brown.
Vara, do.
Bhooka, do.
Kala, or black, do.

The last description comprises a great variety, distinguished by the names of the towns and villages near which it is cultivated. The following are a few of the Kala, or black:

Chachwa,
Paley,
Dhamie,
Vursal, Khanpoor,
Dessarc, cutch,

And a great number of others, which, not being imported here, it is not necessary to specify.

With regard to the character, dimensions, and average number of leaves to a plant, it is difficult to give any correct information. They depend, in a great measure, on the nature of the soil, the manure used, and the water and climate of the country. The leaves of the Melao and Jode are short, being about a foot long by 6 or 7 inches broad, and very pungent in flavor. When dried, they assume a reddish-brown tinge, and are from 8 to 15, and sometimes more, in number. The leaves of the Vurtal and Vara are sometimes larger, and less pungent, than those of the Melao or Jode. The largest leaves are 2 feet in length, by 1½ in breadth, and are generally to be met with in one or other of the different varieties under the head of Kala, or black tobacco. The leaves of this description are bitter in taste. The plant, when full grown, is from 3 to 4 feet in height. The annual yield of the different kinds varies from 2,100 to 6,000 pounds per acre, according to the information furnished by the dealers. The following is the annual production, per acre, of each of the several kinds mentioned below:

Melao	2,100 to 2,700	pounds.
Vara	4,200 to 5,400	"
Bhooka	4,200 to 5,400	"
Dhamie	6,300	"
Vursal and Khanpoor, each	5,100	"
Chachwa	3,000 to 4,200	"
Paley	4,200	"

Much additional information might be procured on this subject, and also on various branches of agriculture, horticulture, &c. Valuable

and interesting researches might also be made in this vicinity on relics, caves, &c., of great antiquity, and geological formations; but it would be attended with considerable expense, and I am not instructed by government to appropriate anything in this way. I would most cheerfully make such researches and furnish full reports.

Comparative statement of the fall of rain at Bombay for the four years past, ending September 30.

Year.	Inches.
1856	71
1857	79
1858	61
1859	81

MISCELLANEOUS.

GRAPE CULTURE IN ILLINOIS.

BY JAMES G. SOULARD, OF GALENA.

After ten years cultivation of the Catawba and Isabella grapes in the vicinity of St. Louis, and twenty years near this city, I am convinced that the high lands in the neighborhood of Galena and Dubuque, (and I may extend this opinion to a considerable portion of the high clay soils in Northwestern Illinois, and in the central parts of Iowa, bordering on the Mississippi,) are much superior for the grape culture to the environs of Cincinnati, St. Louis, or Hermann, in Missouri.

There an average of one half of their Catawba and Isabella crops is lost; even admitting, as I have been informed, that Norton's Virginia seedling, Lenoir, Missouri bird eye, and some other varieties, have been entirely free from the rot around Hermann and other places.

Now, on my farm, a few miles from this city, I never saw the rot in twenty years in a little vineyard of Catawba and Isabella, and a few plants of other varieties, except during three very wet summers, when it exhibited itself in a sporadic form, and then only on a narrow depression of the ground, where there was a great excess of moisture during the whole summer.

In the first six years of my experiment here, I did not cover the vines in winter. They were killed to the ground three winters. But the three seasons they resisted, they yielded well. I then adopted the low culture; starting new wood each preceding year from the ground;

cutting off all the old wood, covering after pruning every fall with a one-horse plow, and uncovering in the spring with the same implement and a six-pronged fork. This can be done very rapidly. During the fourteen years that I pursued covering in this manner, with earth only, I met with but one failure; it was total, however, and caused by continued cold rain and foggy weather, which destroyed the blossoms. The ground had a very gentle eastern slope. Except this failure, every year produced a crop; say, four years light; six years abundant; two years enormous; one year the heaviest I ever saw, and one year the above failure.

The yield was very large in 1857, but most of the Catawba did not ripen well, though the berries on each bunch advanced equally toward maturity. I never saw here uneven ripening; that is, green and ripe berries in the same bunches, nor the vine shedding its leaves during summer. Still, many bunches remained entirely green. My vines were planted from four and a half to five feet apart. I found the same unripe condition, that year, on ground similarly situated, around St. Louis. I believe, even in that season, upon high and steep southern declivities, though not too steep to plow well, they would have ripened in this locality. Continued rain, cool, cloudy weather, and very wet ground through the summer, caused their tardiness.

Covering the vines entirely with earth in the fall is indispensable to success, for two reasons: to protect them against cold winters, and the blossoms from late spring frosts. They should not be uncovered until the season is sufficiently advanced, keeping the vines thus protected as long as the vegetation of the buds will permit, without danger to the crop. Great care should be taken at this time to examine them, on several vines, in different positions, regularly every two or three days.

I give the duration and manner of my experiments, that all may know, how in this northern climate, I arrive at such a favorable and generally unexpected conclusion. This locality, favored with dry, clear summers and falls, having a pervious, friable, clay stratum underlying, to a considerable depth, our fertile light soil, affording easy percolation to any superabundance of water, is unsurpassingly congenial to the perfect production of the grape. The Catawba, whether for table or wine use, for abundance and regularity of yield, and hardiness of plant and fruit, is unsurpassed in this country, among either native or European varieties, while this neighborhood is at least equal, and I think superior, for the culture of the grape, to any other section of the Union east of the Rocky mountains.

FROM H. W. RAVENAL.

AIKEN, S. C., *November* 13, 1859.

I am now engaged in an investigation into the characters of *all* our native vines, with a view to their classification as descendants of some or other of our pure native species. I would prefer waiting, therefore, until I could complete my plan. I have made a beginning in a paper which I read before the "Aiken Vine-growing and Horticultural Association," at a late meeting, and which has been since published in

the "Farmer and Planter." I send you with this a copy. My object in having it published now is to get the aid and coöperation of other vine-growers, and all the information possible on the subject. On looking it over, should you think it proper to give it an insertion, it may be the means of affecting my object and of obtaining additional information.

With the view of clearing up the nomenclature of our native cultivated grapes, which has been brought to a state of great confusion, we have it in contemplation by the "Aiken Association" to invite a convention of vine-growers, to meet us next summer, from all quarters of the United States, in order to unite upon some definite arrangement, and reduce the synonyms to some intelligible form.

PAPER ON GRAPES.

Read before the "Aiken Vine-growing and Horticultural Association," September 15, 1859, *by* H. W. Ravenel.

The grape, like all other domesticated plants long subjected to cultivation, has formed innumerable varieties, differing: First, in *size, flavor, color, and time of ripening its fruit.* Second, in *shape* and *size* of *leaf.* Third, in general thriftiness and vigor of *growth.* These variations are, however, confined within certain limits; and, through all their varieties, they yet preserve their specific identity, and reveal their parentage and origin.

There are certain bounds within which Nature seems to revel in producing changes and combinations of various forms and qualities, but these bounds are never overstepped.

Species in Nature are primordial forms whose characters remain constant through all time, and which are capable of propagating their kind. Within the limits of these specific characters there may be variations. in minor points, occurring sometimes in the wild state, but oftener through the effects of high culture and artificial treatment. Thus, in the United States we have a certain number of species of wild grape. According to the best authorities, the number is reduced to *four* east of the Mississippi. From one or the other of these four species are descended *all* our indigenous varieties. Of these there are now upwards of one hundred in cultivation in the United States, and their number will go on increasing, as seedlings of good qualities are brought into notice. Many of them, no doubt, will prove valuable acquisitions, either for the table or wine-making, but a large number will be thrown aside. There is such a strong temptation to multiply varieties, either as a source of profit to sellers of the vine, or as a matter of pride to amateur cultivators, that the only corrective for the evil will be a publication, at stated periods, of a list of condemned varieties, as is now done by the United States Pomological Society, in the matter of fruit trees.

I am not aware of any attempt to classify these indigenous varieties, and trace them to their proper parentage, to one of the four native species; nor, perhaps, has the time arrived yet when it can properly

be done, from the want of general dissemination, and the difficulty of obtaining many of the latest varieties.

I will, however, give an enumeration of our four American species, with the varieties of each, so far as our information permits:

NATIVE, OR INDIGENOUS GRAPES.

1. VITIS LABRUSCA, LINNÆUS.—*Mx.; Ph.; Ell. Sk. Torr. & Gr.; DeCand.; Prod.*

Fox Grape.—Stem of a pale brown color, the bark more readily exfoliating than in the other species; and the internodes or joints rather longer. Leaves large, three to five lobed, dark green above, densely tomentose or woolly beneath, the tomentum whitish or rusty. Bunches are not very compact nor shouldered. Berries large, dark-blue, with a thickish skin, and always pulpy, with a musky flavor. From this species are descended the following cultivated varieties:

Isabella or Laspeyre, Mary Isabel, Catawba, Bland's Madeira, Concord, Diana, Rebecca, To-Kalon, Anna, Hartford Prolific, Ontario, Catawissa, Northern Muscadine, Minor or Venango, Garrigues, Stetson's Seedling, York, Madeira or Canby's August, Hyde's Eliza, Union Village, Early Chocolate, Early Black, Harvard, Green Prolific, Kilvington, Ives, Charter Oak, Schuylkill or Alexander, Shaker, Sweet Water or Early Muscadine.

2. VITIS ÆSTIVALIS, MICHAUX.—*Ph.; Ell. Sk.; Torr. & Gr.; DeCand.; Prod.*

Summer Grape.—Stem stout and of a reddish brown, with the internodes generally shorter than in the preceding. Leaves broadly cordate, three to five lobed, or sinuately palmate; when young, downy, with cobwebby hairs beneath; smoothish when old; of a lighter green than the preceding. Bunches shouldered and compact. Berries small, round, black, rather acid, never pulpy. From this species are descended the following:

Warren, (Herbemont,) Pauline or Burgundy, Guignard, Clinton, Delaware, Lenoir, (*Black July, Lincoln, Thurmond, Sumpter, Devereux,*) Marion, Traveling, Long Grape or Old House, Elsinborough, Seabrook, King, Ohio or Cigar Box, Missouri, Norton's Virginia.

3. VITIS CORDIFOLIA, MICHAUX.—*Ph.; Torr. & Gr.; DeCand.; Prod.*

Winter or Frost Grape.—Leaves thin, smaller than the preceding, glabrous on both sides, with broad mucronate teeth. Berries small, nearly black, ripening late, and very tart. There are no varieties of this in cultivation that I am aware of.

4. VITIS VULPINA, LINNÆUS.—*V. rotundifolia Mx.; Ph.; Ell.; Sk.*

Bullace, Bullet, or Bull grape, known in Florida and Texas as "Mustang."

Stem whitish, the wood more compact and close-grained than in the other species. Leaves cordate, shining on both surfaces, somewhat three lobed, coarsely toothed, smaller than any of the other species. Berries in loose clusters, scarcely exceeding five or six, changing from reddish brown to black in ripening, with a thick skin and large pulp.

The only cultivated variety is the "Scuppernong," so called after a lake in Eastern North Carolina, where it was first discovered. There may be more than one variety in cultivation under this name, as the so-called "Scuppernong" has been found in other native localities since.

The *Vitis rupestris*, *Scheele*, is found in Texas, about the Upper Guadaloupe, near New Braunfels, and is there known as the "Mountain Grape." It is said to have been found also in Arkansas. Professor Gray, in his description of the plants of Texas, found by Lindheimer, says of this species: "It does not climb, but the stems are upright, and only two or three feet high. The branches are small, and the berries, of the size of peas only, are black, very sweet, and the most grateful, as well as the earliest ripened grape of Texas."

The following comprise a list of native cultivated grapes, which I know only by name, not having had access to any means of information by which they may be classified. They are all, most probably, descendants of *V. labrusca* or *V. æstivalis*, and some may be synonyms of those already enumerated:

Norton's Seedling, Logan, Rock-house Indian or Waterloo, Little Ozark, Graham, Miller's Seedling, Burton's, Early August, Sage, Early Amber, Clermont, Jane, Harris, Long, Baldwin's Early, Louisa, Mary Ann, Clapier, Canada Chief, Secerd's Sweet-Water, Golden Clinton, Senior, Archer, Monteith, Huber.

These are names of grapes taken from various sources, and mentioned as native or indigenous seedlings. After being better known, and with full opportunities for examination of their fruit, leaves, and habit, doubtless we shall be able to classify them, and trace their parentage to one or other of the four American species.

How far the effects of high culture and the propagation of new seedlings from these improved varieties may cause them to deviate from their typical state, it is impossible to foresee; but if our botanists are correct in their limitation of species, these variations must be within the specific characters assigned to the species respectively.

There is one prominent character which distinguishes the grapes of the United States from those of the eastern hemisphere, and that is in the *inflorescence*. All the species of American grapes are *dioecia polygamous*, that is, some of the vines bear staminate or barren flowers only, and are forever sterile. Others bear perfect flowers, and are fruitful.

All the species of the eastern hemisphere are *Hermaphrodite*, that is, every vine bears perfect flowers, containing stamen and pistils, in the same corrolla, and are fruitful. In the absence of other evidence, this fact would be conclusive of the parentage of an unknown seedling, whether it be of exotic or indigenous origin.

FOREIGN GRAPE.

Of the vast number of varieties of the foreign grapes now in cultivation in Europe and the United States, all are referred to the single species, *Vitis vinifera, Linnæus*, a native of the southern parts of Asia. It has been under cultivation more than a thousand years, and was known under many varieties by the ancients.

Upwards of thirty years ago, when Chaptal was minister of the interior, there were fourteen hundred varieties enumerated in the Luxemburg catalogue, obtained from France alone. The Geneva catalogue numbered six hundred. Doubtless they have been much increased since; and, as in the propagation of varieties of other fruits by seedlings, there is no limit to the number that may be brought into existence.

De Candolle, in his "Prodromus," enumerates and gives descriptions of eleven other species of *vine* from the Old World, mostly natives of the southeastern part of Asia; but none of these have been cultivated extensively. The grape of Europe is *one species*, but of *numberless varieties.*

Most of the early attempts at grape culture in this country were with the foreign grapes; but all, without exception, have been failures. The foreign grapes (varieties of *Vitis vinifera*) seem, from their constitution, unfitted to our soil and climate. (I here allude to open air culture—under glass they appear to thrive very well.) How they will succeed when grafted upon the hardy native vine, remains to be proved. Partial experiments, made in Florida and in this vicinity, are promising of success.

If the cause of failure is the greater humidity of our climate, grafting on the wild vine will scarcely prove a corrective, as the leaf and fruit are still exposed to the atmospheric influence. If the cause proceeds from uncongeniality of soil, then grafting upon the wild stock will most probably be successful. As this mode of increasing a vineyard for wine-making must necessarily be more tedious and expensive than by cuttings, it is our policy, as well as true philosophy, to endeavor, by the raising of seedlings, to obtain varieties best suited to our soil and climate.

Every encouragement should be given for the accomplishment of this end, and our association has consulted the true interest of all vine-growers in offering handsome premiums towards that object.

From William A. Forward, *of Palatka, Florida.*

Palatka, Florida, *January* 4, 1859.

I feel it due to Mr. Townend Glover that I should bear testimony to his usefulness in the duties assigned him at this place.

He experimented upon my orange grove, and I consider he has saved it. His syringing of the trees regenerated them, and destroyed the insect. I have no doubt his remedy is a thorough one. It has

certainly proved so in my grove, and others in this town, wherever practiced. I feel that now we have nothing to fear from the orange insect.

From S. M. BAIRD, *of Albuquerque, New Mexico.*

ALBUQUERQUE, NEW MEXICO, *September* 16, 1859.

I know of nothing in this Territory so embarrassing to agriculture and horticulture as insects. They swarm here during the entire growing season in quantities and kinds almost innumerable. One species or another attacks vegetation from the root to the blossom. Wheat, however, is free from weevil and the fly. It has been found nearly impossible to grow potatoes, and many other vegetables in the Rio Abajo, in consequence of insects, and hence the introduction here of any means of destroying them would be a great blessing.

This is the climate and country for the alpaca and cashmere coat. I would also call your attention to the Rocky mountain goat, or sheep, as it is called by the mountaineers, most of whom contend that it is a sheep, though Colonel Bonneville says it is a goat. I have seen nothing of it except its horns, a pair of which I have known to weigh twenty or thirty pounds. Doubtless naturalists by this time have thoroughly examined, and properly classified it, though in the "American Encyclopedia," which contains the only written description, I have found under this name only an account of the antelope instead of the Rocky mountain goat. With the former I am well acquainted, even to the flavor of its meat. Old mountaineers inform me that the latter sometimes grows to the size of three hundred or four hundred pounds, that they are very hardy; the flesh fine for the table; the skin, when dressed of a superior quality, and that beneath the long shaggy hair, it produces a dense coat of wool, as fine as silk or fur, to use their own language. The immense horns would be made useful in the arts.

Should not this animal be domesticated, if possible? The mountaineers say they used to catch the lambs, or kids for pets, and they were easily domesticated. Through the agency of the army now dispersed, or rather located in the mountains throughout New Mexico, Kansas, Nebraska, Utah, California, and Oregon, if the object be desirable, any number required could be procured. Were this animal domesticated, it would surely be superior to anything of the kind now known. The antelope also evidently belongs to the goat family, and I think it might be domesticated without difficulty.

NOTE.—It is a common error to confound the Rocky mountain sheep, *Ovis montana*, which inhabits the whole chain of the Rocky mountains on their highest peaks down to California, and the Rocky mountain goat, *Capra americana*, which is also found there, and on the head waters of the Mackenzie, Columbia, and Missouri rivers.

These animals have a number of synonyms. The sheep have been called "wild sheep of California," "big-horned sheep," "big horn," &c.; the goat, "Antelope americana," "Antelope lanigera," "Capra americana," &c.

Of the Capra americana, Audubon says: "The coat is composed of two kinds of hair, the outer and longer considerably straighter than the wool of the sheep, but softer than that of the common goat; the long hair is abundant on the shoulders, back, neck, and thighs; on the chin there is a thick tuft, forming a beard, like that of the latter animal. Under the long hairs of the body there is a close coat of fine, white, silky wool, quite equal to that of the Cashmere goat in fineness. The resemblance to some of the antelopes, the chamois, the goat, and the sheep, caused it to be placed by some authors under several genera."

Of the Ovis montana: "The hair" (of the male) "bears no resemblance to wool, but is similar to that of the American elk and reindeer. It is coarse, but soft to the touch, and slightly crimped throughout its whole length. The hairs on the back are about two inches in length; those on the side, one and a half inches. At the roots of these hairs, especially about the shoulders and sides of the neck, a small quantity of soft fur is perceptible. The legs are covered by short, compact hairs. The horns of the male are of immense size.

"The female Rocky mountain sheep resembles some of the finest specimens of the common ram. Its neck is a little longer, as are also the head and legs, and, in consequence, it stands much higher. Its horns resemble more those of the goat than of the sheep, in fact. Whilst the fine, erect body of the male reminds us of a large deer, with the head of a ram, the female looks like a fine specimen of the antelope."

From C. R. BUCKALEW, *Minister Resident.*

QUITO, ECUADOR, *January* 16, 1859.

Great importance has been attached to the cinchona tree, which furnishes the Peruvian or fever bark. There can be no doubt that some parts of our country are adapted to its cultivation.

It is found in Ecuador, as well as in Peru, Bolivia, and New Grenada, and its value as an article of commerce has very greatly increased during the last half century. In this country it formerly sold at forty dollars per hundred, while its present price is one dollar per pound. These prices are in Ecuadorian currency, to reduce which to United States money requires a deduction of about one-fifth. In Ecuador the tree is found at elevations of from six to eight thousand feet, and where the temperature ranges from 60° to 66°. But, as Humboldt observes, a comparison between the climate of these regions and others is not satisfactory, and it does not follow that the tree will not flourish in temperatures quite different. Within a few years, seeds of the tree have been sent to England and propagated, in order to be forwarded to India. The plants are forwarded thither in boxes, glass-covered, with what success remains to be seen.

The seed is diminutive, and may be sent by post to remote countries.

In Northern Ecuador, and west of the mountains and of Quito, the inferior kind is found. The red bark variety, which is most valuable, is everywhere becoming scarce before the depredations of the hunters, and, as no care is exercised in its cultivation or preservation, it may, after some years, unless attention is turned to the subject, become nearly extinct. The most valuable and extensive forests of the tree are situated in Southern Ecuador, in the vicinity of Loxa, and it is from that quarter, so far as this country is concerned, that supplies are drawn.

Information regarding the cinchona tree may be found in Humboldt's Personal Narrative, volume 1, page 138, and more particularly in his Views of Nature, (Bohn's translation, 1850,) pages 280, 390, and 422, in note.

From my position here, I enjoy peculiar facilities for obtaining the seed of the tree and information regarding its culture, and, in concert with the Patent Office, would take efficient steps towards its introduction into the United States.

From S. B. Parsons, *at Lausanne.*

I have been seeking for the Italian bees which I was desired to procure by the Agricultural Division of the Patent Office. I found that a mixed breed could easily be obtained throughout Lombardy, and that little care is taken to preserve them pure. I succeeded, however, in finding an enthusiastic bee cultivator in Mr. Hermann, of Tamins, who makes frequent incursions in Lombardy, and selects wherever he can find them, the pure queens of this breed impregnated by pure males. They are easily distinguishable by a broad yellow band across the abdomen. The proboscis is also longer, enabling them to feed on many plants which are beyond the reach of common bees. They are also about one fifteenth larger than the ordinary breed. A small hive will make sixty to seventy, and an old hive one hundred to one hundred and thirty pounds of honey in a season. Mr. Hermann's experience in shipping bees renders reliable his decided opinion that they can be safely sent to America only in the autumn, and that it is essential to send them by steamer, as they would not endure a long voyage.

I have purchased of Mr. Hermann ten hives, to be forwarded from Havre. In order to insure their safety, I purchased old hives. I will furnish a more detailed report on these bees, including drawings. It will describe the best mode of educating the queens, of preserving their purity, and increasing their number. Until spring, the only attention these hives will require will be that which is given to ordinary bees.

It will be expedient to make no distribution before another year, as I can describe a mode by which these large hives can be increased to six hundred small ones, each with a queen, and each of which can be placed in a box six inches square for more convenient transportation over the country.

I appreciate very highly the value of these bees. I think that their acquisition alone would have merited a special mission from America.

I am in receipt of a letter from the director of the botannic garden at Odessa, in which he states that "the industrial vine culture of the Crimea is principally of well known European kinds, while there are to be found also some varieties which are native to the country, and some obtained from the Trans-Caucasian provinces, from China, Persia, and the river Amoor. Of such, however, it would be impossible to obtain five thousand cuttings in the space of one season. The culture of the olive is very limited in Southern Russia. For some time the demand for young plants has been only from the Trans-Caucasian provinces. That demand has now nearly ceased, and the nurseries have so small a stock on hand, that they could not furnish this year more than four hundred or five hundred plants. The remaining four thousand five hundred can be supplied in the autumn of 1861."

This state of things renders useless any visit to the Crimea, and I wrote him that I should not wish the vines of western Europe, as they are already abundant with us, but that he might send as large a part of the five thousand cuttings as can be obtained this year, and the remainder another season, all to consist of sorts from the Trans-Caucasian provinces, from Chiva, Persia, and the river Amoor. I requested him also to send one hundred scions of each Crimean variety of apples, pear, cherry, currant and quince. I wrote him that I wished the novoli of the olive. He wrote only of plants, and I have therefore requested him to send five hundred now, and I would write him this winter whether the remaining four thousand five hundred would be desired another year.

WINE-MAKING IN NEW YORK.

ITHACA, TOMPKINS COUNTY, NEW YORK,
January 18, 1860.

SIR: I received from the Patent Office, about a year ago, a tin case, with two grape-vines inclosed in moss, marked "grapes from Hungary." These I set in a pot, in the latter part of February, 1859, and early in May took them out, and set the younger and most thrifty of the two in a favored spot on the south side of my house. By cold weather last fall it had grown two main vines, one four feet seven inches, and the other five feet two inches ripe wood. This vine is short-jointed; eyes, or buds, prominent; leaf cleft, and resembles most foreign grapes in appearance; have cut away two-thirds of the ripe wood, and distributed the cuttings to my neighbors. So far it has stood out of doors, borne 3° Fahrenheit below zero, and appears hardy, and uninjured by the frosts of this winter. The other vine was old wood—at least two or three years old; appears like the other; grew badly, (only some sixteen or eighteen inches;) ripened the wood badly. Transplanted at the same time, (May,) but to a richer soil, in a less sunny spot.

As to wine-making, let me add that this valley, three hundred to eight hundred feet deep, at the head of Cayuga Lake, has always been noted for its fruit. The vintage of this town, in 1858, was about 1,000

gallons, of which over 600 gallons were made by my press. The result has been some 700 to 800 gallons of wine that will compare very favorably with any of Europe or America. Especially do the still Catawba and Isabella mixed compare with the bland German and French wines brought home by travelers in their trunks; that is, a sweet, mild, spiritous, bland wine, suited to the sick chamber, sacramental, and table use. If asked, as a chemist and manufacturer, from my experience now of fifteen years in wines here, how can wine be made in Central New York? I should reply, that the variety made of the same grapes can be very great, and by the *mere manipulation* you can produce variety in color and roughness and quantity of spirit. As the Catawba usually ripens poorly, a fine wine is made here by one-third half-ripened Catawba, and two-thirds ripe Isabella, and if the manipulation has been correctly made, cannot easily be told from the best Catawba.

Again, the manipulation can vary the quality to suit the time of sale and use. I speak all the while of no additions of any substance whatever, except *sugar* or *refined syrup*. The wines soonest ripened will not keep the best or longest.

A fine wine, ripe for use in six months, may be made by crushing half a bushel of grapes at a time in a butter (Orange county package) firkin, with a handle (broom or hoe handle) inserted into a round block of hard wood, sawed off square at both ends, a style I prefer, and putting thirty gallons so crushed in a forty-five gallon alcohol barrel for a fermenting tun. Add two pounds of sugar to the gallon, and ferment as long as the color deepens. The moment the color ceases to deepen, put to press, transfer the pure juice immediately to a close cask, and let the fermentation go on as rapidly as possible. Keep the room so hot that it shall not be over twenty days before the fermentation ceases spontaneously. Then put into a cool cellar, and when clear, a *strong red wine* will result. If you have succeeded in the manipulation, this wine can be used at once, and will give good satisfaction to the palate. It is much admired for its rich, splendid colors, like Bohemian red-stained glass, clear and pure. But it will not keep well.

Probably the best wine we can make in this valley of Cayuga Lake is by the following manipulation. Use the hoe, or broom-handled block, round, with square ends—say a piece of locust, five inches in diameter and six inches long; crush just hard enough in your butter firkin to mash the pulp and lacerate the skins of the grapes, but not crush the seeds, half a bushel at a time, putting, as before, 30 gallons into an alcohol cask, with one head out for a fermenting tun. To every gallon add one pound of sugar, or equivalent of clarified syrup. If sugar is used, boil in sufficient water or wine to dissolve it—the longer the better, before you add to the mashed grapes—making 30 or 35 gallons in your 40 or 45-gallon fermenting tun. Ferment rapidly, by maintaining such heat that you can hear the bubbling and a hissing sound from the tun all over the room. The color will deepen, and then fade, when the supernatant skins and pulp have become dingy and muddy, and the must or liquor pale reddish amber color, put to press, and pour the must or grape-juice into the cask, where it is to ripen. Ferment again rapidly, so that not over twenty-five days shall elapse before the fermentation shall cease spontaneously—that is,

twenty-five days from the time of crushing the grapes. Put in a cold, dry cellar, and bung up tight. Rack in February and again in April, or just before the "sweating in" commences. Complete the "sweating in," or the second fermentation, in fifteen days if you can—that is, so regulate the heat that it will be over *spontaneously* in that time. Allow it to clear by standing two months; rack and let it stand one month, and rack again, adding at this last racking as much sugar as will suit your taste—say one to one a half pounds to the gallon. I you have succeeded in the rackings just named, no further fermentation will take place; and if the fermentation has been good, the wine will be sweet enough to suit any one, at a pound and a half to the gallon. You can pass it off to any one as the most delicious, bland, foreign wine that can be named. In color, it is amber, or reddish amber; mild and bland in taste, high in its aroma, sets quietly on the stomach, produces no flatulency, and is a wine every way worthy of the name. Of the vintage of 1858, I treated twelve casks on this principle, and failed only in three of them. One became vinegar, the other two somewhat acid; the grapes were from five or six different graperies. The vinegar cask was unripe Isabellas; the other two mixed, unripe Catawba and unripe Isabella.

The New York State Agricultural Society, in 1858, took strong ground against the addition of sugar. The committee on wines call sugared wines "cordials," and not wines. I simply add, that I have a dozen samples made without sugar in various ways, of careful, unadulterated manipulation. A flat, tart, insipid, high-colored (red or straw-colored) fluid is thus made. This wine can be remedied by the addition of "acetic ether" and "ethereal oil of wine." If these gentlemen say they add no sugar, but do add the gluten of wheat and starch, they are probably not aware that they use sugar in disguise.

In judging of wines, and to suit the common taste, it must be remembered that we are not a wine-drinking people. The mass of the nation form their ideas of wine by that used at the sacramental tables of our churches. And in these a factitious mixture of wine, brandy, or alcohol, drugs, and especially "acetic ether" and "ethereal oil of wine"—an oil made from the distillation of alcohol—is the main element that reaches the taste, and then only when excessively sweetened. Hence, if a rare and choice bottle of foreign wine is carefully brought home by a traveler, and tasted by an American, it is condemned. So, too, of a choice native wine in most cases. The drugs that make the decided taste on the tongue are not there; neither is the excess of sugar. I have known the choicest wine of Palestine condemned as no wine at all, and the Hock of Germany pronounced as without character, because of this false opinion thus formed.

Henceforth, wine-making will assume more and more importance. Lastly, I would add, that a market is the main demand of our valley. Of the wines of 1858, we probably have in town over 600 gallons ripe and for sale. With unreasonable suspicion we can find no ready sale, but in time this will be overcome.

I would say to the novice in wine-making, avoid putting the unfermented wine in casks in a cold cellar, and thus avoid the slow fer-

mentation in the cask for from three to six months. Such wines never ripen; we have them, thus treated, of 1854, 1856, and 1857, yet unripened and acid. All our wines tend to a claret. I am inclined to the belief that the best "stumming" of casks is to fill them with weak lime water, and let them stand two or three weeks; the addition of pulverized lime stone to the mash would be useful to prevent acidity. In my experiment it fell in crystals to the bottom of the cask in a year to a year and a half.

Respectfully,
S. J. PARKER, M. D.

Hon. WILLIAM D. BISHOP,
Commissioner of Patents.

From the UNION HORTICULTURAL SOCIETY, *Penn Yan, Yates county, New York.*

The grape commands the attention of our horticulturists, many of whom have already advanced far in its cultivation. In this vicinity there have been not less than one 1,636 gallons of wine made. The amount of grapes sold at distant markets is 10,960 pounds, and probably as much more consumed or kept for home consumption. Over 20,000 vines will be set out during the coming season in this county, and an equal number in the neighboring country. Wine has been made from nearly all our varieties of grapes, with varying success, as may be expected when inexperienced men engage in a new enterprise. The business is extending, and is destined to become important.

The native grape has been converted into wine with good results. The vine is hardy and thrives well, and the fruit is dark-colored, rich, and pulpy. It is tart in a high degree. For heavy wine, it seems admirably adapted, and its rich pulp will admit sugar without rendering it light and insipid. It will, no doubt, be sought for to color and flavor wine of other varieties.

In our latitude, 42° 40″, with our variety of soils and climate; in the vicinity of the Seneca Lake, which is about 450 feet above tide-water, and never freezes; also of the Crooked Lake, 720 feet above tide-water; with our slopes and highlands, 800 feet above the lakes, and with our valleys and exposures to all points of the compass, we have natural facilities to become acquainted with the habits, properties, and modes of cultivation of every kind of grape. Such varied circumstances will make the study pleasing and the result profitable. We have in our vicinity the climate of the lake country and its breezes, and the climate of the river countries, with their sunshine, frost, fogs, and mist. Near the lakes, it is true, are places effected by fog and mist in autumn, where the rot or mildew will be a most certain destroyer; but at others, only a few miles distant, fog is seldom seen, and the autumn frost is slow to appear.

SILK CULTURE.

By L. Constant, *of Cat Springs, Austin Couuty, Texas.*

Familiar with the climate of Southern Europe, and for twelve years a resident of Texas, I had my attention directed long ago to silk culture. Several attempts to import eggs, *via* Bordeaux, proved unsuccessful, the worms having already left their eggs, when I came into possession. At a later period I ordered from Bolzani, a silk-raiser in Berlin, and received them in a perfect state, though transported in winter. They were well packed in linen. Without paying them any special attention, I kept the eggs, still so packed, in a drawer, from the 1st of January to the 10th of May, without injury. At an average temperature of 74° F. I soaked the eggs for some six hours in a mixture of brandy and water, wiped them well with a piece of smooth linen, and put them into a small, flat, wooden box, exposing it to the rays of the sun, covered slightly with a few mulberry leaves, which, as they withered, were constantly substituted by fresh ones. During the nights, I kept the box warm by putting some cotton loosely around it. By this method, differing altogether from that used in Europe—where the eggs are hatched either in rooms of an equal temperature, or on the bosom of females—I succeeded very well. After six days all the vigorous worms had left their eggs, appeared very lively, and partook freely of the young leaves of *Morus multicaulis.* The feeding was done on the usual wicker-work, placed in my room, which was kept open by day and shut at night. When a warm and equal temperature began, which lasted during the whole month of June, it was a very favorable period to the worms; yet I was surprised at the extraordinary facility displayed by them in completing their four changes, and pleased to find that, on the twenty-eighth day after their birth, the transformation into the chrysalis had already begun. On the sixth day after their birth I transferred part of the worms into the open air, removing them from the wicker-work to the mulberry trees, by fixing there the branches of those leaves already occupied, from which they soon spread. They continued in good health, appeared lively, and became more vigorous than those kept in the room. I did not supply the former with any huts, in which to go through the process of changing into the chrysalis; but those kept in the room were furnished with shocks made of fine straw, and similar to small brooms, without a handle. On the thirty-second day after their birth they had already involved themselves, or begun their spinning. I possessed one fourth of an ounce of grains, the fourth part of which was hatched, and the rest I threw away, so as not to raise worms of different ages. They produced somewhat over a pound of cocoons, which, either together with their huts or collected from the trees, were put into a box lined with coarse linen, and placed in a dark corner of the room. After ten days the insects crept out, and within four days laid seven eighths of an ounce of eggs, which kept very well until next spring; but, on the occasion of a heavy rain, they became

wet and unfit for use, simply because the mischief done had not been noticed until too late. From the close attention I devoted to them, I found that not a single worm became sick or died in the course of their development; and almost without an exception they went through the changing process with ease and rapidity. They were fond of the leaves of the *Morus multicaulis*, eating them with avidity; but refused those of the wild mulberry of this region. The worms raised in the open air were vigorous, and their cocoons beyond all objection. The silk was equal to the best obtained from Turin, the thread of the cocoon being some 500 to 700 yards in length. It is my intention to continue these experiments.

THE RADISH, AND FRUITS OF JAPAN.

By TOWNSEND HARRIS, *United States Consul, Simoda.*

The statements in the "World in Miniature," concerning the Japan radish, are much exaggerated. It is true, that radishes are grown in every part of Japan, but nowhere are they a principal article of food; they are merely an adjunct to rice, wheat, and barley, which are the great staples of the country.

I ordered the best specimens of the long radish to be brought to me when I first visited Yedo; the longest were less than thirty inches, and about one inch in diameter. This radish, when dried, loses more than three-fourths of its bulk, and looks very like a whip-thong. Specimens of another kind were also brought to me. These were shaped like our parsnip; the largest measured eighteen inches in the length, and fifteen in circumference, and weighed four pounds and five ounces, avoirdupois.

All the radishes of Japan, when used as a salad, are inferior to the garden radish of the West, being tough, and not of an agreeable flavor. When boiled they are quite insipid, having nothing of the flavor of the white turnip or rutabaga.

Only trifling attention is paid to the cultivation of fruit in this country; cherry and plum trees produce magnificent blossoms, but bear very little fruit, and that little worthless. Peaches are far inferior to those of China, being quite bitter; and the same remark will apply to the apricot.

I have seen only one variety of pears; they resemble in shape and color a russet apple, but are unfit to eat raw, and when cooked are quite insipid. The best grapes of Japan are like the Catawba in appearance, but inferior to that variety.

The only fruit that I have seen in Japan that particularly merits notice, is the Kaki, a variety of *Diospyros*, and belonging to the order *Ebenaceæ*. It is really worthy of being introduced into the United States. Many kinds have been brought to me. One has a skin as

thin as tissue paper, and the pulp resembles in flavor the Egyptian fig. Another variety has a thick rind and a finer pulp, while the taste strongly reminds me of the delicious mango of Siam and Bombay. The tree is very ornamental, and of rapid growth; it would, no doubt, succeed in any part of the United States south of 37° of latitude. Unlike the persimmon of the United States, there is very little astringency in the skin of the fruit, and frost, which matures the persimmon, greatly injures the kaki. This fruit varies in size, but is always larger than its American relative, and some are seven inches in diameter; it is in season nearly three months. The Japanese dry it, when it will keep for some four months, and has a taste like that of the dried Smyrna fig.

From Beverly L. Clarke, *United States Minister Resident to Guatemala.*

VEGETABLE TALLOW,

Known to botanists by the name of *myristica sebacea*, comes from a nut about the size of a nutmeg, full of meat, which, being melted, produces a yellowish tallow, excellent for candles, but until now very little used or known even here. I have no doubt this article might be collected and exported with considerable profit. It is grown upon a bush or shrub, in its wild or uncultivated state, in immense quantities, in the southern departments and in Vera Paz. It is susceptible of such high purification as to resemble the finest sperm, is solid, and quite as transparent. A sample of this production in the nuts, in the form of tallow, is forwarded with this report.

ORCHARD-HOUSE CULTURE.

By Dr. George Pepper Norris, *near Wilmington, Delaware.*

Orchard-house culture, recently introduced into the United States, bids fair to give great satisfaction. Many varieties of fruits cannot be grown in the open air, on account of insect pests, and this plan, by the construction of proper houses, will, in the course of a few years, effect a great change in the manner of growing fruits. No work on this subject has yet appeared in our country, but horticulturists are much indebted to the editor of a prominent journal on horticulture, for republishing Mr. Rivers's book relating to it.

This mode of culture has been successfully tried in England, and a number of houses have been constructed adjoining our large cities. One in Philadelphia, that of Mr. Lovering, is two hundred feet long, and although but a short time in operation, has already produced the most satisfactory results.

Orchard-house culture, with us, will probably be confined to the peach, plum, apricot, and nectarine. The three latter fruits are now

almost entirely neglected in this vicinity, on account of the ravages of the curculio. Fruits of the kinds above named are intended to be grown as dwarfs, in pots, and by a proper course of pruning and summer pinching, with liquid manure, will succeed in producing fine crops. A house for this kind of culture may be thus described:

Suppose one to be desired 30 feet long. Stake out the ground, 30 feet by 12 feet 6 inches wide; place 6 cedar or chesnut posts 3 feet deep, leaving 7 feet 6 inches above the surface of the soil. This is for the back row. Plant another row of posts 12 feet 6 inches in front of these back posts, to project above the ground 3 feet. Nail strips along the top of the back and front rows, for the rafters to rest on. The rafters will be 14 feet long, and the roof to be made of glass, permanently fixed, in the manner adopted by all nurserymen for their grape and pruning-houses, with two additional posts at each side, for doors. It is now ready to board up. The front, back, and sides should be finished with well-seasoned 1-inch plowed and grooved plank. This gives us a house 30 feet long by 12 feet 6 inches wide; 7 feet 6 inches high at the back, (probably 7 feet 9 inches with the back plank,) and 3 feet 3 inches high in the front. It is nothing but a lean-to glass-roofed house, made perfectly tight, but capable of being all thrown open, as will presently be described.

Everything will depend on the ventilation. Glass shutters, 3 feet long by 20 inches in width, should alternate in the roof, to be raised up. The boards along the front should be on hinges, to let down. There should be 6 shutters, on grooves, 3 feet by 1 foot 2 inches, near the top, 2 half-way down, and 2 at the bottom. This, with two doors, one at each end, will give the requisite air. It will be understood that a house is desired capable of being made perfectly tight, when necessary; at the same time, we can, by opening all the shutters and doors, give an abundance of air. The walk through the center of the house is made by sinking the path 18 inches below the surface, and planking up the sides. The front row of trees will now be placed in pots directly beneath the glass, and 3 feet apart; the back will require to be raised according to the size of the trees. Pot fruit trees require a strong, hot sun, with plenty of air, and protection from cold spring winds. The cost of such a house as I have described should not be over $120, and by careful management may be built for considerably less. Mr. Rivers's estimate is under $80 for these dimensions, but is too low. Pot fruits are now for sale by all the prominent nurserymen, with instructions how to prune and cultivate. Five years will, in all probability, witness very numerous houses of this kind throughout the country. A plan in detail will be found in the Horticulturist, for June, 1859 [published by Saxton, New York.]

THE HANG-WORM.

MARYLAND AGRICULTURAL COLLEGE,
Prince George's county, Maryland, December 21, 1859.

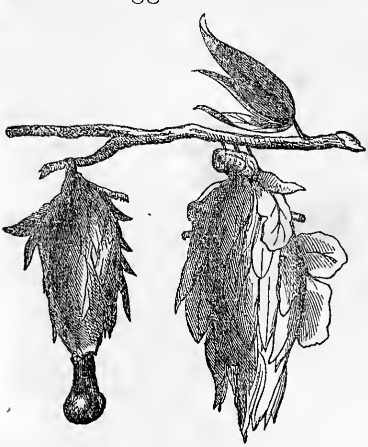
SIR: I am sorry I did not receive Mr. Chambers's interesting communication to the Agricultural Division of your office until a few days ago, it having been misdirected.

Mr. C. C. Chambers, of Flemington, East Florida, complains of the ravages committed upon the cotton crop in his neighborhood by a species of caterpillar, unknown to either himself or the planters in his immediate vicinity, but which, from his clear and lucid description, (the specimen inclosed in his letter being unfortunately lost,) I have very little hesitation in pronouncing to be a species of the *Oiketicus coniferum*, commonly known in this State as the hang or drop-worm. This name has been given to it from the peculiar habit the caterpillar has of forming a case, and hanging suspended from the leaves or branches of the trees and shrubs upon which it feeds. As the natural history and instincts of our *Oiketicus*, or hang-worm, are most probably much the same as the Florida species, and may prove interesting to Mr. Chambers, I will endeavor to describe them, in as plain language as possible.

The eggs are deposited at the lower end of the hard brown envelop, or apparent chrysalis of the female insect, and inside of what Mr. C. terms the "cocoon," which "case" also serves as a protection for the insect when in the soft-bodied, caterpillar state, and is formed of silk, interwoven with pieces of stalk and leaves, upon which the caterpillar feeds. The interior is carefully lined with a fine floss-like silk, to protect the naked skin of the caterpillar from the rough ends of its outer envelop. When the warm weather commences, these eggs, having remained in the case all winter, hidden from the prying eyes of insectivorous birds and protected from the cold, hatch, and the young worms emerge into the case from an aperture in the anterior part of the female chrysalis case, caused by a splitting open of the upper part of the hard and shelly material forming the outer envelop of the female. The young worms then find their way into the outer world through a hole purposely left in the lower end of the leafy case, and beginning to feed upon the tree, immediately form a minute case adapted to their small size, from the gnawed fragments as before stated, and which they gradually enlarge, from time to time, as they grow, until the autumn, when they attain their full and perfect size; in the meantime merely protruding their heads to feed and six fore feet to crawl from place to place. Still, however, they retain their case or movable house, firmly attached to their naked bodies by means of their hinder feet, which grasp, or retain hold of the case with such tenacity as hardly to be capable of being dislodged without tearing the worm to pieces. When the caterpillar of the male is full grown, it casts the caterpillar skin and assumes the form of a pupa, in the same manner as other *Lepidopterous*, or scale-winged insects, and remains in this state a longer or shorter time, according to the state of the weather. It finally pushes itself out of the lower end of the case, through the opening left purposely by the caterpillar, the minute spines on its body facilitating this mode of exit; and the anterior part splitting open, a small black four-winged fly or moth makes its appearance, having the body black and hairy, and wings transparent wherever the down or scales have been accidentally rubbed off. This moth might readily be mistaken for a fly from its singularly fly-like appearance and transparent wings; but, in reality, belongs to the order of *Lepidoptera*, or butterflies and moths, the same as the cotton caterpillar and boll-

worm. The male insect having wings, immediately seeks out, and pairs with the first female he finds, quietly reposing in her case, which she never leaves—this serving, at different times, first as her house, then as her nest, and finally, as her coffin. Pairing being over, the male dies, the female deposits her eggs in the case, as before stated, and likewise dies, leaving the eggs to be hatched by the genial heat of the next season's sun. Late in the fall, and during the winter, many small cases or cocoons may be seen suspended on the leafless branches, each with a black chrysalis case protruding from its lower extremity; these are the cases of the males, that have undergone their transformations, and paired with the females. The larger cocoons are those of the females, and contain the dried up body of the insect, in the posterior part of which may be found from seven hundred to one thousand eggs; embedded in and covered on the upper part with a thick layer of brownish dust, apparently composed of the down of the mother's body. These eggs, if not destroyed, will all hatch, and in a short time defoliate all the trees in the neighborhood, the young worms being so light as to be carried by the wind from tree to tree, with the greatest facility, as I have found them on almost every shade tree in Washington, not even accepting the flat cedar. They do not appear to be very choice in their selection of food.

I wish I could procure from him as many as a dozen cocoons, to hatch the eggs therein contained, and compare the perfect insect with our own, as I have already figured one *Oiketicus* or hang-worm found on the cotton plant in Georgia, and was satisfied that it was almost, if not absolutely the same as our own *Oiketicus coniferum*, or case-bearing hang-worm, if I may so term it. Last year I found two specimens on pine in Florida, but of a much larger size, and may probably be the same species as that found by Mr. Chambers, as there were cotton fields in the immediate vicinity. As I have spent so much time in describing the insect, I must touch upon the most important part to the agriculturist, the best means of destroying it. As the insect fastens its cocoon securely to a branch or twig, when about to change, and as in winter, the trees here are entirely defoliated, and these pendant cocoons, also containing the eggs, are plainly visible, they should be torn off and immediately burnt. Each female case, as I have before stated, contains from seven hundred to one thousand embryo worms, and if not destroyed in time, might increase so fast as to do much damage to the crops. I would here remark, that this fall, I found a peculiar small black and yellow banded Ichneumon fly, very busy depositing her eggs in these cocoons. The parent fly deposits one or two eggs in the body of the hang-worm inside, and hatching into pale yellowish white, footless grubs, devour



Male, with chrysalis skin protruding. Female, with head and six fore feet out, crawling.

the interior of the rightful possessor of the case, leaving untouched only the hard shelly covering of the female, in which they change into pupae, and afterward, in the spring, gnaw their way out of the murdered insect, and brood, as perfect four-winged flies, having a slight resemblance to a very small black wasp, marked on the hind body with light yellow bands. I regret that I have no specimens of these flies at hand, in order to be able to describe them in a more intelligible manner. I have also observed other smaller ichneumon flies destroying the hang-worm, in a manner somewhat similar; and merely mention these facts in order to warn Mr. Chambers not to mistake the beneficial parasite for the really noxious insect, should he, or his neighbors, choose to watch their transformations and habits another season, as I hope they will do, and report to the office the results of their experiments. It is generally from practical planters that we learn the true history of the insects destructive to their crops. As to Mr. C.'s theory of the cotton caterpillar, I confess I am unable to judge about their appearance, at stated intervals, like the locust, (*Cicada leptendecim;*) but, from what I have seen, am inclined to think that the seasons have more to do with it than he imagines. A slight frost will kill the chrysalis in its loosely-spun cocoon, and I have been unable to find either eggs or perfect insects in the winter, not having remained the whole year in the South.

I remain with respect, your obedient servant,

TOWNEND GLOVER.

Hon. William D. Bishop,
Commissioner of Patents, Washington.

Letter from N. H. Morague, M. D., *of Palatka, Florida.*

Palatka, Florida, *January* 10, 1859.

Mr. Townend Glover, late entomologist of the Agricultural Division of the Patent Office, and myself, commenced last summer a series of experiments upon my orange grove for the purpose of eradicating the insects; "insignificant animalcules" as they appear to the eye unassisted by the microscope, yet they were devastating my trees in such a manner that I had almost resolved to abandon the culture.

After trying various experiments with but little success, such as sulphur and lime, aloes and whisky, coal-tar, soda, syrup, &c., we came to the conclusion to try Peruvian guano, and made a solution according to the following proportions:

To a barrel of soap-suds add a common bucket of guano.

I may here remark that the instrument used in applying these remedies was a tin syringe, with numerous minute holes perforated in the end; a number of which instruments Mr. Glover was kind enough to have made and presented to several persons in this community. We syringed my trees once a week for a month or two, and I am happy to say with complete success. Although my grove was literally covered with the coccus, not one can now be found alive.

If they return, I shall pursue the same plan, satisfied that I shall gain a two-fold object: first, ridding the trees of the insect, at least for a time, and secondly, benefiting the trees very much by the wash and drippings of the guano.

FROST.

BY WILLIAM H. BREWER.

The frosts of June of 1859 were so very disastrous to the crops of this county that I have thought the subject of sufficient interest to record for future reference. They were unsurpassed and even unequaled by any that ever occurred in this country, (so far as I can ascertain,) if we consider the great extent of territory affected, the lateness of the season, and the magnitude of their disastrous results.

The mean temperature of the month of June was several degrees lower than usual in most of the Northern States, and at some places where records have long been kept, (as at Rochester,) several degrees lower than ever before noticed.

The 4th of the month was generally the coldest day, and at the Toronto Observatory, (Canada,) the coldest of any day in June for over twenty years, while similar notes came from other points. The night was still colder, and brought a disastrous freezing frost. Snow fell during the day at Toronto, Niagara, Forbes, Buffalo, Syracuse, &c. In many places in Western New York, as at Avon, the ground was white. Scattering flakes also fell in parts of Ohio.

The mean temperature here for the day was 20° F., the evening observation being 34° in a sheltered place. The night was perfectly clear; how low the thermometer sank I have no means of knowing accurately, but probably to about 25°, or even lower, which is 23° below the lowest temperature for June, 1857. On the morning of the 5th a frost-like snow generally covered the ground, while the bare surface was frozen to the depth of over one fourth of an inch, and ice formed on the water in the most exposed positions over one fourth of an inch in thickness. This was the frost that did the most of the damage here and in the adjoining counties, but in some places it was less disastrous than the succeeding ones. Probably, also, it spread widest, having been felt over a large part of New England, where it did but little injury. Over the most of New York it was very severe, especially in the central and western parts, and did much damage in Ohio and Pennsylvania—these three States suffering particularly. It extended south to Maryland, being further south on the east than on the west side of the mountains, affected also the most of Michigan, much of Illinois and Indiana, Kentucky, (as far south as Lexington,) Missouri, Wisconsin, Canada, and Iowa, probably to the Missouri river. A diminution of temperature was felt as far as North Carolina, and perhaps further south. In some places the frost made its appearance on the night of the 3d, as in Berks county, Pennsylvania; but this was not usual, and even in those cases the day of the 4th was the *cold day.*

In parts of New York a heavy frost followed on the night of the 5th, in various places, on the night of the 6th, then, extensively on the night of the 7th, which was severe in Northern New York. It was felt in Vermont and Massachusetts; I know not how wide. Again, on the night of the 8th it was severe in places in Northeast, especially in Maine. On the night of the 10th, it was most severe in places in New York; on the 11th and 12th, there was frost here, the first very slight; that of the 12th severe enough to destroy much which the first frost had spared. In some other places ice formed of considerable thickness, but none here. Frost followed in still other places on the night of the 13th. From this last date, the weather here steadily grew warmer, until the 28th, when it reached 94°, about the hottest of the season, and then cooled again until we had a slight frost on the morning of the 4th of July.

In this series of frosts, the region of greatest disaster may be defined as a belt extending from Auburn, New York, to Columbus, Pennsylvania, the northern edge of this belt curving considerably to the south, in Western Pennsylvania, but severe damage was done outside of this in certain localities, embracing the most of New York, north and west of the Catskill mountains, the most of Pennsylvania west of the mountains, the most of Ohio, and parts of Michigan, Indiana, Illinois, Wisconsin, Massachusetts, and Canada. If we take its entire range, it included also all of New England, east to the Atlantic, south to Maryland, parts of Virginia and Kentucky, the States before enumerated, west to the Missouri river, (possibly further,) and north to an unknown distance.

The effects were generally less severe in the immediate vicinity of large bodies of water. A slight fog rising from the Ohio protected the immediate valley near here; a strip along the northern shore of Lake Erie was protected in a similar manner; in fact, this was observed along many other bodies of water, as Seneca and Cayuga Lakes, and the other lakes of Central New York. But a partial exception was seen around the southern end of Lake Michigan. In the vicinity of Chicago the injury was very severe.

The effects of elevation and exposure were various and remarkable. In some situations, even in this vicinity, the valleys and sheltered places suffered least; in others, not distant, the reverse was the case. Some fields of wheat seemed to have been frozen by the wind, which protected others, and often localities quite near each other, suffered very unequally.

The different states of advancement of the crops in different localities was another cause of divers effects. At no place where the temperature sank so low was vegetation further advanced than here, hence no locality suffered more. Throughout the country wheat was in full flower, some fields beyond that stage, other grains proportionately advanced, apples over an inch in diameter, and ripe cherries had been in market from the vicinity for several days, while other fruits had duly progressed.

It may be well to notice some of the immediate effects and appearances. Corn, of course, was killed, as far as it was frozen, that which was furthest advanced being entirely lost. Wheat was injured most

by freezing in the soft parts of the stalk, generally in the sheath of the upper joint, and the stalk immediately below the head. Hundreds of acres were thus totally destroyed, but in some cases it seemed as if the damage had been done in the head itself, although it was rare at harvest to find a head partially killed; in probably ninety-nine cases in a hundred the head was entirely killed, or escaped nearly unharmed; that is, produced its full number of grains, though often less plump than usual.

From many microscopical examinations made the next and succeeding days, I am convinced that the young grain and the flower could and did stand the cold better than the succulent parts of the stalk. Consequently, in certain cases, it was extremely difficult to tell the extent of the damage, until about two days after. In some cases the young grain, or *ovule* would have a perfectly normal appearance, and the pollen grains preserve a natural color and shape; yet the head be subsequently found to be entirely killed by freezing below. In other cases the grain and parts of the flower soon showed the injury, the ovule becoming more pulpy, and at first a deeper blue than its natural color, and the hairs which enveloped the plants and anthers would all show cells ruptured or withered by the freezing.

As before remarked, it was rare to find a head with a few perfect grains, and the rest blasted, but much more frequently the grains that were left filled, but imperfectly, as if the stalk had but partially transmitted the sap.

The other cereal grains suffered less, early barley the most. North of us, where the grain was not so advanced in growth, much less damage was done.

In sections of New York, where ice formed half an inch thick, and where the wheat was but just coming in head, little, if any, injury resulted, and better crops than usual were harvested.

Forest and other trees were much affected. A vigorous growth of young wood had been formed, still succulent, and the more tender parts were killed, both of the cultivated evergreens, even hardy kinds, and the native and the cultivated deciduous trees. Of the native forest, the white ash and locust suffered most. The former had its leaves and fruit entirely killed, and many of the young trees died; the older ones put forth new foliage. The locust fared scarcely better; by the 10th or 12th the trees were bare, and the ends of the young wood killed, but towards the close of the month, fresh foliage put forth, and about the 11th of July, many put forth a second crop of flowers, especially the younger trees. The inflorescence was much more sparse than at the usual date, yet sufficiently abundant to be quite conspicuous.

Most forest trees here have produced little or no fruit this summer. Hay was not heavy, but good, and buckwheat an unusually good crop. Apples, such as escaped, grew well, but have shown a great tendency to rot, even the more durable kinds.

A supposed effect has been the destruction of insects. Whether this be the case or not, it is a fact that insects of all kinds have been unusually sparse the past summer, especially those kinds most injurious to the farmer. The wheat midge has been everywhere less

destructive than last season, wherever the frost reached, and parts of Western New York have reaped a plentiful wheat harvest, the first for many years.

The aggregate damage to the farmer of this county can now be better estimated than before. Those most competent to judge, estimate that, instead of selling as usual, the county must buy at least $250,000 worth of breadstuffs; and that the total loss to the farming interest will amount to upwards of $1,500,000.

From WILLIAM MUIR, *of Laborville, Melrose Post Office, St. Louis county, Missouri.*

NOVEMBER 29, 1859.

The Meramec Horticultural Society of this county numbers forty-one active members, beside honorary and corresponding members in different portions of the Union. Its first year is nearly closed, and has been signally successful. Conducted on the itinerant plan, its meetings are held once a month at the houses of members in different parts of the township.

Our first fair, at Allenton, was well attended.

I obtained from a nurseryman two small tubers of the Chinese yam, the refuse of his season's sales, which, although late in June, I planted. They received no culture, except keeping down the weeds. In the spring, when I took them out of the ground, where they had remained during a severe winter, without mulch or other protection, they died off eight inches from the surface, the remainder being quite good. Their average length was twenty-six inches, circumference at the base five inches, and weight six ounces, some being thirteen ounces. I replanted four tubers entire, to see how much they would increase; cut the others into two hundred pieces, trenched the earth three spades deep, and made a bed one foot higher than the surrounding ground. I then planted the sets one foot apart each way, and two inches deep. They did well, and became fully as large and heavy as the former. I have obtained 2,500 bulbs from three quarters of an inch in diameter to the size of a pea. The plants had no manure, and the ground had only been three years free from timber, with a clay subsoil. A little more culture would produce larger yams. This piece gives at the rate of 16,335 pounds to the acre, with no labor but to weed after planting.

We have cooked the tubers in various ways: plain boiled, good—superior to the common potato; fried in dripping, very good; plain baked in the oven, and eaten with or without butter, pepper, and salt, excellent; grated, and made into pudding, pronounced superior to sago, tapioca, or any of the kindred articles in common use for puddings. I intend cultivating the yam largely, and to make a series of experiments, which I will record and forward.

From Rev. James T. Barclay, *Jaffa.*

April 12, 1859.

One large box and a barrel of seeds, &c., were this day shipped on board the French steamer for Beirût, where my son will transfer them to the vessel about to sail for the United States, as also another box of articles that he has collected at that port.

Very much to my regret, the departure of the vessel from Beirût was postponed to so late a period that vegetation was far too much advanced to justify the transmission of cuttings, slips, bulbs, &c., although I had procured tin cases of various capacities, and made every arrangement for sending the larger portion of the articles.

Believing that hedge-plants for live-fences are very much needed in some portions of the United States, and quite desirable everywhere, I have devoted special attention to this subject, and am much pleased with the result, as I trust you will be, also, on receiving the cuttings. Finding several varieties of wheat in this country, differing very materially from each other, and all, I think, superior to those at home with which I am acquainted, I propose sending a barrel or two of each kind from the present growing crop.

Among the varieties of grapes with which this land abounds is the seedless species of Hebron—excellent both for raisins and wine—which will probably succeed well in many portions of the United States, and will accordingly be sent. The Sultan is supplied with water-melons from Lake Gallilee, said to be the finest in the world, and of the seeds of this variety I shall procure a good supply.

From O. R. Buckalew, *Minister Resident.*

Quito, Ecuador, *April* 20, 1859.

I send you seeds of the following Ecuadorian plants:

1. *Thibaudia acuminata.* A very beautiful shrub, of four to five feet, found only in ravines, toward the base of Pichincha. Its flower is tubular, elongated, crimson, but white-pointed, lustrous, and produced in clusters. The berry is globular, dark purple, pea-size, and edible. Leaf oval, but extremely pointed, from which the specific name. The tender shoots and young leaves are reddish. It is mostly found in rocky situations, which may indicate its treatment in cultivation. It is not known that it is domesticated anywhere, although among the most ornamental shrubs. Hardy and evergreen.

2. *Rhexia* (genus.) This is a fine, hardy shrub, of four feet, found abundantly on Pichincha, at elevations of from ten to thirteen thousand feet. The flower is white, but has a red cup. The leaf is small, wrinkled, and pretty. Evergreen.

3. *Melastoma* (genus.) This is one of the very finest of the Andean plants. A hardy, evergreen shrub. The leaf is elegant in form, and lustrous. Flower white, small, and fragrant. The berries are pea-size, and pleasant to eat. Height, four to five feet.

4. *Alstrœmeria caldasii.* This plant was named by Humboldt in honor of Caldas, a New Granadian naturalist. It is a climber and twiner, of eight to twelve feet, hardy and perennial. The flowers are produced in bunches of twenty to fifty; are orange-colored, spotted in the inside, an inch and a half long, and are showy. They are followed by curious pods, of triangular form, which eventually burst, and present clusters of red berries, (the seeds,) reputed to be a dog poison. The plant also produces tubers, by which it may be propagated. I obtained the seed of this interesting plant at twelve thousand five hundred feet on Pichincha.

Elevation of Quito, 9,500 feet. Range of thermometer from 48° to 69° Fahrenheit during the year.

From David L. Gregg, *Consul at Honolulu, Hawaiian Kingdom.*

The cotton plant or shrub is found on many parts of the Hawaiian islands, growing wild. It is supposed to be analogous to, if not identical with what is commonly called Sea Island Cotton. About the year 1837 its systematic cultivation was attempted on Hawaii by Governor Kuakini, (John Adams,) but he did not persevere for a long time, owing to the want of proper information and skill in preparing his crops for market.

Mr. F. A. Oudinot, formerly of Kentucky, is now trying the experiment of raising cotton near Lahaina, on the island of Mani. When he took possession of his farm there, a few years since, he found quite a number of shrubs, or trees as he calls them, in a wild state; some, as near as could be ascertained, from fifteen to twenty years old; all, however, in full vigor, continually displaying their blossoms, and at the same time opening their matured bolls. He has inclosed and planted a small field, and, thus far, has found it to do well. In dry seasons he thinks the shrub produces much better by "topping it."

He has furnished me with several specimens taken from shrubs respectively five months, five and a half months, one year, two and a half years, and fifteen years old. I take the liberty of inclosing a small quantity from those of five and a half months and fifteen years growth. Specimens to any moderate extent, or seeds, can be forwarded if it should be deemed desirable.

At Lahaina, where the soil and climate are perhaps as favorable as anywhere in the whole Archipelago, Mr. Oudinot supposes the production may, by careful cultivation, be made to reach as high as one thousand pounds per acre in the course of a year. This estimate may seem high—and it is undoubtedly beyond any probable average of crops—but I do not entertain a doubt that cotton can be produced successfully and profitably in nearly all the sheltered valleys of the kingdom.

The fineness of the fiber is supposed to diminish with the age of the shrub on which it is grown. This the samples in my possession seem to prove beyond all question.

No especial pains appears to be required in the cultivation of the

cotton shrub beyond plowing the ground thoroughly in the first instance, and subsequently keeping it clear of weeds and undergrowth. The distance apart at which the seeds should be planted depends, of course, somewhat upon the nature of the soil and position.

A great proportion of the surface of the Hawaiian Islands is mountainous. Not more than three eighths, at the utmost, is susceptible of easy cultivation, and of this but a moderate part is included in valley ranges, or so situated as to be sheltered from the strong winds which prevail during most of the year.

This kingdom can never produce largely of anything which enters into commerce. As yet its resources are in their infancy. It unquestionably possesses the elements of a fair degree of prosperity, but the strong hand of industry is required to develop them.

WOODEN SHOES.

Experience has shown that a number of diseases, often resulting in impaired constitutions, and even in the loss of life, have been contracted by a portion of the farming and laboring population in consequence of wearing leather shoes, when engaged in their operations during cold weather, or in wet situations. To prevent those evils to some extent, wooden shoes are extensively worn in France and Germany. They are highly recommended by the agricultural societies and governments of Europe. Impressed with their importance, the board of commerce and trade of Wirtemberg called a practical workman from France to give instruction in their manufacture. The person now recommended by the board of agriculture of Wirtemberg is Wilhelm Baumann, of Obersontheim, Oberambt Gaildorf, Wirtemberg. Not allowing water to penetrate, as leather shoes do, they are naturally dryer, capable of keeping the feet warmer, prevent diseases, by promoting the requisite and salutary perspiration, and are regarded, to a great extent, as life-preservers, even in such cases where salt baths, the use of wheys, and other medicaments, proved quite ineffectual. There is hardly an operation on the farm and about the farmhouse in which they could not be profitably used. They are most economical about stables, where leather shoes are exposed to the destructive attacks of dung-water, in plowing, mowing, harvesting, in doing earth-work in vineyards, chopping wood, and in marketing. With these advantages, in a salutary point of view, they combine such durability as to last almost a lifetime. They are light and easy to wear, being provided with a small cushion on the upper side, within, so as to obviate any pressure on that part of the foot. They are of a neat and pleasant appearance, either of their natural color, or blackened or varnished. Their size is large enough to allow the wearing of comfortable stockings; in addition to which they are provided with leather straps. Their price ranges from fourteen to thirty-six cents—shoes for children being still less. These advantages will certainly entitle them to the attention of a portion of the farming, manufacturing, and laboring population of the country.

From Hon. JOSEPH WRIGHT, *Minister to Prussia.*

UNITED STATES LEGATION,
Berlin, March 22, 1859.

SIR: Yours of the 22d of February, with the eight boxes of seeds, has come to hand. The Prussian minister of agriculture, Count Pückler, who has taken charge of most of the seeds, and given notice to all the experimental schools in anyway connected with agriculture throughout Prussia of their receipt at his office, assures me that he will see that they are properly distributed, and that a fair trial be given them.

He states, also, that he will most cheerfully have prepared by the fall a collection of such seeds as you may wish to be forwarded to your department.

I have sent a portion of the various articles presented by you to the celebrated agricultural school of Hohenheim, as well as to Hanover, Brunswick, Saxony, and other parts of the Zollverein. I shall be most happy to make such collections of seeds, as you may suggest, to be transmitted next fall or early in the ensuing spring.

I have received from the Hohenheim Agricultural College, one of the oldest in Europe, copies of their reports, exhibiting its system and managemeut. If furnished with a list of the agricultural colleges and schools of our country, I will forward to you for their use these reports, with all the statistics which I may hereafter obtain from the various agricultural institutions in Germany. I am anxiously awaiting copies of the last Reports of your department.

I have the honor to be, most respectfully, your obedient servant,

JOSEPH WRIGHT.

J. HOLT, Esq.,
Commissioner of Patents.

From A. J. SMITH, *United States Consul.*

LAGUAYRA, VENEZUELA, *June* 8, 1859.

I transmit to you the seeds of a few choice fruits of this country. These are such delicious fruits that it is worth a trial to grow them, even in a hot-house. The large seeds are from the fruit called mama, which resembles in flavor a fine clingstone peach. I have seen them eight inches in diameter. They are almost round, and in the market have the appearance of the balls used at ten-pin alleys. The trees producing them attain an immense size, and are the finest for shade to be found in this country. The morag seed, shaped like a small shell, is a very pleasant fruit also, and unique-looking; the seed grows partly out and partly in the fruit, and has the appearance of pods of red and yellow pepper. The chillemoha, or cherimoya, as it is pronounced, is certainly the most delicate in its flavor of all the fruits in the world,

and at the same time very healthy. I find, indeed, that all fruit is healthy to a person who does not drink spirits of any kind.

These fruits would grow in Florida, Texas, or even Louisiana, if taken care of until they start properly, when they will become very hardy. They are found on the tallest mountains, in the greatest abundance, and bear, in this climate, all the year round. The interior of this country abounds with a great variety of fruits and cereals, which would be a decided acquisition to the fields and gardens of the Southern States. I have seen, since my arrival here, both vegetables and animals of which I never saw specimens, even in our museums.

From ERNEST VOLGER, *United States Consul.*

BARCELONA, SPAIN, *August* 18, 1859.

The algaroba is a very useful tree in this country, nearly related to the sweet locust or honey locust tree of the Southern States. Its pods are, however, larger and sweeter, and contain more than sixty per cent. of sugar. They are broken to pieces, when horses, mules, jacks, and other cattle are fed on them. There is no better and cheaper food for them, and the tree can be planted on the most sterile, rocky, and sandy land. I remark, however, that this tree does not prosper where it is not exposed to the exhalation of the sea. All along the coast of Catalonia and Valencia it is never found beyond the first ridge of hills. The shores of our Southern States would therefore be best adapted to make the experiment of acclimatizing this very useful tree.

From WILLIAM STORY, *of Jamestown, Fentress county, Tennessee.*

I send you a full account of my experiment with the Hungarian grass.

On the 10th of June, 1858, I received a pint of Hungarian grass seed from the Patent Office, and on the 11th I sowed it on a piece of rich clay land. I at first plowed the ground with a shovel-plow, which left the surface very rough and uneven. I then took a harrow and ran over about one fourth of the patch, leveling the surface very smooth and even. After sowing the seed on all the ground, I again harrowed the patch. The ground was very dry, and the weather continued hot for about three weeks; consequently it was sometime before the seed came up. When they began to appear, I was soon sorry that I had not harrowed all the ground before sowing, for where I had omitted this operation, but few seed came up; in the uneven places they were covered too deep.

Notwithstanding the extreme heat of the sun, the grass grew astonishingly fast, branched out beyond all expectation, looked nutritious, luxuriant, and green, and grew about waist-high by the 1st of August. It was headed out like millet, though seeming more vigorous and hardy.

By the 10th of August, the heads, which were from one to six inches in length, were all turned of a golden yellow color; and the blades, which were very soft, long, and thick, and set on the straw from the ground to the head, were of the same hue. I then cut it and bound it in sheaves, like wheat or oats. After it had cured a few days, I threshed off the seed, cleaned them neat and clear of chaff, and measured them. I had sixty-three pints of seed from one pint sown. I am confident that not more than half of the seed came up, and consequently the sixty-three pints were the product of half a pint of seed.

I gave some of the hay to my horses and cattle; they all seemed as fond of it as of sheaf oats. The seed was very heavy, and, I think, far superior to threshed oats for feed, as they appear to be more oily and nutritious. The hay, without the seed, will probably be excellent feed for horses, cattle, and sheep. Unthreshed, it will likely be superior as feed to the best of sheaf oats.

In Tennessee, it should be sown about the first week in May, on clean and loose ground, harrowed smooth before sowing, and then harrowed or brushed after. One bushel of seed, I think, will sow three acres. It should not be cut till the heads get yellow, if the seed is to be sown. I recommend the Hungarian grass to be the best and most nutritious of all grasses, and I shall rejoice when our State is well supplied with its seed.

From O. H. Kelley, *Corresponding Secretary of the Northwood Farmers' Club, Wright county, Minnesota.*

The distribution of seeds, received from the Patent Office the past season, has resulted in the formation of one of the most efficient organizations of farmers of which our new State can boast. Having been chosen as corresponding secretary of the same, I will describe the plan which has been adopted for future distribution of seeds. Owing to the small quantities contained in the parcels of wheat, oats, &c., making it considerable labor to save enough for subsequent trials, all that may be received, say of wheat of one variety, is given to one farmer, another variety to a second, and so on. At the end of the season, and after the grain is threshed, it is to be left at the secretary's office for the inspection of all the members of the club. If the result is favorable, the same person has the privilege of sowing the whole another season, and half the product then becomes the property of the club, and is distributed as they see fit. So with corn, and all seeds that may mix by being planted in too close proximity with seeds we now raise. By this method we can keep the seed pure; and, as nearly all our members are practical farmers, we shall take great pains to give each variety of seeds a fair and impartial trial.

We now number some thirty members, and intend to hold meetings, during the winter, one evening of each week, for discussions upon agricultural topics. Samples of every kind of grain and other crops are left with the secretary, at his office, for public inspection.

With most of the seeds received the past season, our success has been good, and may be summed up as follows:

Melons.—The ice-cream watermelon proved to be very fine, and is well worth cultivation.

The Green Citron.—This did not produce so well as we wished; but will give it further trial. We have had a very poor season, as far as the weather is concerned, for ripening melons, owing to much rain.

China Beans.—These did very well, ripening early.

The distribution of King Philip corn and Chinese sugar-cane has given to the farmers of Minnesota two of the most valuable crops we can raise. Of the corn we must speak in the highest terms; it matures the last of August or the first week of September, and we finished husking the first of October. With proper attention, it yields an average of seventy bushels per acre, on sandy soil; husks very easy; and the meal is considered far superior to any other kind, for making bread. It is sure to be out of the way of early frosts, and can be all housed long before cold weather sets in.

The sugar-cane must prove a valuable gift to us. Most of it raised this season was planted too late to allow the seed to mature; though I secured about a quart from my lot, well ripened. The result of an experiment with the cane, as made by Mr. Cooley, is as follows:

He planted one acre and one fourth with cane. The greater part o the seed was sorghum, and the rest imphee. He gives a decided preference to the imphee. His product of syrup was about 350 gallons.

A large number of our farmers will send to Chicago this winter for seed of the sugar-cane, and we anticipate a large crop next season; so that, in all probability, syrup will sell in the fall of 1859 for twenty-five cents per gallon—a price which will pay the manufacturer, as the consumption of the article will very much increase. At the present rates of from fifty to seventy-five cents, it is cheaper than Louisiana molasses has been with us for several years.

Whatever prejudice may exist against the distribution of seeds from the Patent Office, many of us in Minnesota feel under great obligations to your Office for such valuable gifts.

Chufas, or Earth Almonds.—These prove to be indigenous to our soil and climate, being found in rich bottom lands, and on the borders of some of our marshes. The cultivated, however, are much larger than the wild, and are eagerly sought by the gophers, which devoured the larger share of my crop. As a substitute for coffee, they are good; though I consider peas to be equal, and they are harvested much cheaper. Chufas, moreover, will probably prove to be a bad plant to spread in cultivated ground.*

Kohl Rabi.—This species of the turnip is certainly a beautiful plant when growing, and will be valuable for feeding to stock.

Cabbages.—The numerous varieties received did well, with the exception of the *Couvé tronchuda*. This yielded a stalk upward of two feet high, profusely covered with leaves, but did not head. The *Early York* ripens very early, and is much esteemed. The *Ox-Heart* is a variety true to its name, and very plump and sound; it is a good cab-

* Mr. Kelley has erroneously connected the wild nut-grass (*Cyperus repens*) with the esculent from the south of Spain, (*Cyperus esculentus.*) The chufa belongs to the same genus but does not possess the power of spreading itself voluntarily.

bage. The *Savoys*, however, are the general favorites for winter use.

New White Globe Onion.—This is a finely-flavored onion, but did not succeed very well. It is, perhaps, better adapted to a more southern latitude.

Salsify.—Will give this another trial next season. The root, this year, was much smaller than an ordinary-sized parsnip.

Celery.—This will receive another trial; needs forcing in a hot-bed.

Lettuce and Cucumbers.—All did well. Consider the curled variety the best.

Peas.—The Early Emperor and Champion of England are decidedly the best varieties we have yet raised; the latter being a late variety with us.

Victoria Pie Plant.—This produced stalks from the seed this season, some as large as those from roots in the garden seven years old.

Crimson Clover.—This was sown rather late, but grew well, and the seed matured finely. It has a large, cone-shaped head, and is of a bright crimson color. By its rapid growth, it must gain favor wherever introduced.

Some attention is now given to the raising of tame grasses, as experience of ten years here has plainly shown that it is folly for the farmers to depend upon the marshes for wild hay. It will sometimes, in certain localities, bear cutting two and three years in succession; but the second crop is generally much lighter than the first, whereas, in other places, the first cutting is followed by a thrifty crop of thistles and weeds of endless variety.

The new organization, the Northwood Farmers' Club, is composed of several of the members of the old Benton County Agricultural Society, which has sunk into oblivion, owing to the county having been divided into four new counties. To attend the meetings of that society, many of the members were obliged to travel fifty miles each way. By having clubs scattered through the counties, where members can meet more frequently, and in their own neighborhoods, much more beneficial results will follow. The office of our club will be kept open during business hours, and we intend to have several papers on file, and a corrected list of wholesale and retail prices of products of the farm. Each member will also register, in a book kept by the secretary, the amount of grain he wishes to dispose of, or if he desires to purchase any stock, making it, at the same time, a ready place to purchase and sell anything appertaining to the farm.

Hereafter, the success or failure with seeds from your Office will be made out in full, at regular meetings of the club, and printed copies will be forwarded to you.

From JOHN DANFORTH, *of New London, Connecticut.*

I received from the Patent Office some California pumpkin seeds, which I planted in my garden early in the spring, with two rows of green corn of thirty-six hills. The pumpkin seeds came up soon and well, ran from forty to sixty feet, and blossomed and set well; growing as fast as cucumbers in the month of September. The green corn was

cut up at the roots, and the sun admitted to the vines; they were taken in and harvested before frost. I had over one hundred of the finest and best California pumpkins that were ever seen together in any of our Northern States. Their weight was about four tons, some single ones weighing over one hundred pounds. It takes about six months to raise them in our climate. The ground must be rich and good. I put a wheelbarrow-load of the best hog manure into each hill of corn and pumpkins. I also planted some of the seed where an old hog-pen had stood. They were neither hoed nor weeded, yet ran sixty feet, and I took pumpkins from the vines weighing over one hundred pounds. They sell readily in our market at two cents per pound. I will furnish the seeds by return mail to any applicant who will send post office stamps.

I also received from the Patent Office a paper of Boston marrowfat squash seeds, which I planted in my garden, and raised about a dozen of the largest and finest squashes that I ever saw; the largest of them weighing from forty to fifty pounds. When they were cut open, they would smell like a ripe musk-melon. I have sold some of them at three cents per pound. The ground was rich and manured in the hill, which had a southeastern exposure.

From O. B. Nichols, *Corresponding Secretary of Clinton County Agricultural and Mechanical Association, at Carlyle, Illinois.*

December 10, 1859.

I received from the Patent Office a parcel of Tuscan wheat, for experiment, in the fall of 1858. I put it in drills, 10 inches apart, and cultivated with the hoe. On the 27th of May the rust made its appearance, and rendered it worthless; May red, which stood only about 30 feet from it, was not affected. I also tried some white wheat, with the same result. I did not cut either variety. An experience of 22 years of wheat raising in the prairie satisfies me that, as a general rule to insure success, we must sow the earliest varieties to be procured from the south. Of 22 crops, I have never lost but one, and that was sowed on the 30th of January.

Not one farmer among the six who tried the Tuscan wheat succeeded.

The turnip seed proved worthless, except the Yellow Malta and the Snow Ball. The Ox-heart and Drumhead Cabbage proved first rate, and also all three of the varieties of beets, namely, the Large Scarlet, the White Sugar, and the Small Early Castelnaudry. Mangold wurzel and beans were fine; the squashes not good; but the best of all was the delicious nutmeg and ice-cream watermelon.

The law of Congress for the collection and distribution of seeds should immortalize the names of every member who voted for it.

From J. A. Mertz, *Secretary of the Union County Aricultural Society, Pennsylvania.*

Organized November 13, 1852, and chartered September 19, 1857, our present number of members is 150. The amount required for

life-membership is $10. Our other modes of obtaining funds are by selling admission tickets on fair days. We at present possess 10 acres of land, valued at $2,000. A fair or show is held once a year, in October, when from $200 to $400 are awarded as premiums. The largest ever offered were for the best blooded stallion, $6; and for the best short-horned Durham, Alderney, or Devon bull, $5. We have a course on our ground. Every fall an account of our transactions is published in the county newspapers.

The benefits resulting from our organization are manifest; a feeling of ambition has arisen, which must ultimately produce great and permanent good to every interest. Blooded animals, of the domestic breeds, have been introduced, and are now being crossed upon the common stocks. The average yield of crops has increased, and farming and the mechanic arts generally have improved.

From CHARLES A. LEAS, *United States Consul at Revel, Russia.*

JUNE 16, 1859.

I send samples of very hardy Livonian and Esthonian wheat, rye, and barley, which are cultivated to great advantage in this sixtieth degree of latitude north, in a common limestone soil, and which I think would succeed to a good growth in the northern portions of the United States. The flavor of this rye, when converted into spirits, has for many years been pronounced, in France and Germany, *most desirable* for the making of wine and Holland gin. For those purposes large quantities are annually shipped from this place.

From W. M. WEST, *of Plattsmouth, Cass county, Nebraska.*

JANUARY 1, 1859.

This county being mostly prairie, the scarcity of timber is our greatest annoyance. The soil is well adapted to the production of the various fruits and vegetables of this latitude.

The wheat crop of the past season was attacked by rust, and consequently almost a failure; the Mediterranean or Black Sea wheat being the only variety that succeeded. Corn has yielded well, and appears to be unusually nutritious. All other crops have been very good, except potatoes, which were not more than half so productive as usual. These results are attributable to the superabundant rains which have visited this country for the last seventeen months.

The various grasses introduced here have prospered, but the prairie grass answering all purposes, little care is taken to procure foreign varieties. Cultivated fruits are confined to a few varieties of grapes, plums, cherries, gooseberries, currants, and raspberries. The native grapes of this vicinity are inferior; but there is a variety of native plum, some of which are worthy a place in the most select collection. The native gooseberries are large, and entirely smooth.

The first settlement in this county was made in 1854. The first crops were raised in 1855. In 1856, an agricultural society was organized, which held the first fair in October of that year, and the exhibition of horses, mules, cattle, sheep, swine, poultry, vegetables, dairy products, and needle-work would have honored some long-settled eastern counties. Each annual fair shows rapid improvement, and we expect to stand first in the agriculture of Nebraska.

CONTRIBUTIONS OF SEEDS, CUTTINGS, &c.

The Agricultural Division of the Patent Office is indebted for seeds and cuttings to many persons, both at home and abroad. These are at all times acceptable, though some *have been* received, we regret to state, in a condition unfit for germination, while the greater part would not bear transmission to distant localities. The recent erection of propagating houses in Washington, which are under the control of this Office, will enable the department to test all contributions, to increase the amount of those proving valuable, and to distribute them in vigorous condition over the country.

It is proper, also, to acknowledge the receipt of many seeds and remarkable products presented by successful growers. Participants in the distributions should exert themselves to disseminate over their own neighborhoods seeds of the best varieties raised. Should they, on the other hand, have any new or important seeds, which they desire to make more generally known, the Agricultural Division will take pleasure in instituting experiments and distributing the product.

From abroad, the Office has to acknowledge various favors from our ministers and consuls, many of whom show increasing interest in agricultural matters, and a commendable disposition in this respect to render their residence in foreign countries materially useful to their fellow countrymen at home.

Among numerous contributions we select the following:

1858.

March 17.—Grape cuttings from Dr. Th. Koester, secretary of Comal County Agricultural Society, New Braunfels, Texas.

March 31.—Four boxes of grafts from United States consul, Basle, Switzerland.

April 2.—Sixteen varieties of flower and vegetable seeds from Professor Blunee, of Calvert College, New Windsor, Maryland.

July 3.—Seeds from Algiers and China from Marshal Vaillant, minister of war, France, per Alexander Vattemare.

August 2.—Australian wheat, (2 pints of,) yield fifty to seventy-five bushels per acre, from Mr. William Dougherty, Berrien Springs, Michigan.

August 5.—Two boxes of "Espirito santo" plant from C. A. Raymond, purser of steamship Moses Taylor.

August 20.—Venetian sumac, received from Charles F. Loring, Austrian consul general, New York.

Sept. 8.—178 specimens of seeds, presented by the Imperial and Central Horticultural Society of Paris, and forwarded by Alexander Vattemare.

Sept. 11.—Plum stones, (*Prunus chiccasa*,) one quart, by Major H. C. Williams, from Santa Fé, New Mexico.

October 6.—Seeds of white summer wild grape from farm of Dr. Sutphin, Liberty, Bedford county, Virginia.

Nov. 1.—Four bundles of wild rice from J. Volney Swetting, Berlin, Wisconsin.

Nov. 9.—A can of live-oak acorns from Palatka, Florida, sent by Mr. Glover.

Dec. 1.—Seeds of Kaki, a delicious variety of persimmon, from Townsend Harris, consul general, Simoda, Japan.

Dec. 17.—470 leaves and berries of Yaupan from Beaufort, South Carolina, per Edward Ralph, jr.

1859.

April 20.—Three cans of grape cuttings from Governor Steele, of Peterborough, N. H.

April 26.—A sample of wax, and seeds of wax tree (*Rhus succedanea*) from Japan.

May 24.—Sample of cotton, coffee, sugar, India rubber, from Cerea, Brazil, sent by United States consul at Pernambuco, W. W. Stapp.

May 28.—Seeds from Hon. C. R. Buckalew, resident minister, Quito.

July 11.—Bottle of pawpaw brandy for analysis, from John Law, Evansville, Indiana.

July 16.—Box of tea seed from Hon. R. K. Meade, envoy extraordinary, &c., Rio Janeiro, Brazil.

July 14.—Seeds from A. J. Smith, United States consul Laguayra, S. A.

Aug. 1.—Samples of wheat, rye, and barley, from Esthonia, per United States consul at Revel, Russia.

Aug. 21.—Two cans of Berkeley county grapes, from Dr. R. McSherry, Martinsburg, Va.

Sept. 2.—Seeds of black grape, from James Topling, Liberty, Va.

Sept. 5.—Two quarts of Roanoke wheat, from Charles Heermann, of Hundermark, Darby post office, Pa.

Sept. 5.—Box containing bulbs, fibers, grasses, &c., from United States consul, Cape of Good Hope.

Sept. 10.—Seeds of trees, shrubs, and plants, from W. C. Hampton, Mount Victory, Ohio.

Sept. 29.—Bottle of Vuelta Abajo tobacco, from United States consul, Havana.

Oct. 20.—Received one barrel and two boxes of seeds, Rev. T. J. Barclay, Jerusalem, Holy Land.

Oct. 29.—Sixteen samples of vegetable seeds, from S. B. Tucker, St. Louis, Mo.

Nov. 1.—One bushel bag of Algaroba beans, (Carob, or St. John's Bread,) from United States consul Barcelona, Spain.

Nov. 9.—Can of smooth barked hickory, from H. Z. Abell, Welshfield, Ohio.

Nov. 14.—Tree seeds from W. C. Hampton, Mount Victory, Ohio.

Nov. 14.—Seeds from J. W. Shaffer, Fairfield, Iowa.

Nov. 14.—Sixteen bunches of Los Angeles grapes, ($2\frac{1}{2}$ to 3 pounds each,) from M. Keller, Los Angeles, California.

Nov. 28.—Strawberry watermelon seeds, from Yucatan, and spice melon seeds, from T. N. Hornsby, Fisherville, Ky.

Nov. 30.—Velvet and crimson spinach seeds, from William Newlove, of Penn Yan, N. Y., per Charles Ketchum.

Nov. 30.—Eleven bags of dried grapes, from Dr. Henry Connely, of Albuquerque, N. M.

Nov. 30.—One hundred cuttings of grape vine, from William Clark, of Northampton, Mass.

Nov. 30.—One hundred cuttings of sweet-water grape, from N. Harding, Boston, Mass.

Dec. 1.—Plum pits, from the mountains near Downieville, Cal., from A. T. Langton, postmaster.

Dec. 1.—Received bottle of pawpaw spirit, from Dr. Jackson, of Boston, for Hon. John Law, of Evansville, Indiana.

Dec. 5.—Bundle of tree seeds, from Robt. Howell, of Nichols, N. Y.

Dec. 5.—One hundred grape cuttings, (*Dracutt Amber*,) from Asa Clements, Lowell, Mass.

Dec. 12.—Received from Beverly L. Clarke, United States minister resident at Guatemala, box containing sample of vegetable tallow, made from the "*Myristica sebacea*;" nuts accompanying.

Dec. 14.—One hundred cuttings, and bundle of seeds of Concord grape, sent by Hon. E. W. Bull, of Concord, Mass.

Dec. 27.—Box of osier willow, from Hartford, Conn.

PATENTS FOR AGRICULTURAL INVENTIONS OR DISCOVERIES FOR THE YEAR 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Bee-hives	John S. Harbison	Sacramento, Cal	Jan. 4, 1859.
Bee-hives	William L. West	Elmyra, N. Y	Feb. 8, 1859.
Bee-hives	George C. Aiken	Nashua, N. H	Feb. 15, 1859.
Bee-hives	George H. Clarke	East Washington, N. H	Mar. 1, 1859.
Bee-hives	William Powers	Youngstown, Ohio	Mar. 8, 1859.
Barley, pearl, machine for making	August Wulze	St. Louis, Mo	May 3, 1859.
Bee-hives	Simon H. Walker	Somerville, Tenn	May 31, 1859.
Bee-hives	Ruggles S. Torrey	Bangor, Me	June 7, 1859.
Butter, machine for working	Josiah Seymour	Coventry, N. Y	Dec. 20, 1859.
Butter, machine for working	Joseph Jones, assignor to self and Jas. G. Bryce	Philadelphia, Pa	July 5, 1859.
Bees, device for feeding	William Brown	Shelbyville, Ind	June 21, 1859.
Bee-hives	John K. Leedy	Woodstock, Va	July 12, 1859.
Bee-hives	Horace Gushee and J. G. Dawes	San Francisco, Cal	Oct. 11, 1859.
Bee-hives	John W. Palmer	Point Republic, Va.	Nov. 1, 1859.
Bee-hives	Eli Bartholomew	Cleveland, Ohio	Nov. 22, 1859.
Bee-hives	T. S. Underhill	St. Johnsville, N. Y	Dec. 13, 1859.
Bee-hives	John S. Harbison	Sacramento, Cal	Dec. 13, 1859.
Corn-shellers	M. Bomberger	Hummelstown, Pa	Jan. 4, 1859.
Corn-shellers	William Wells	Boston, Mass	Jan. 4, 1859.
Cultivators, cotton	Calvin Cannaday	Indianapolis, Ind	Jan. 4, 1859.
Cultivators	George W. Tolhurst	Liverpool, Ohio	Jan. 4, 1859.
Cultivators	John B. Duane	Schenectady, N. Y.	Jan. 4, 1859.
Corn-shellers	A. B. Vaut and A. M. Cook	Millford, Mass	Jan. 11, 1859.
Cultivators	Jesse Cunningham	Marshall, Mo	Jan. 18, 1859.
Cultivators, cotton	John M. Hall	Warrenton, Ga	Jan. 18, 1859.
Corn-huskers	Abbott R. Davis	East Cambridge, Mass	Jan. 25, 1859.
Clover-pickers	William T. Mills	Galesburg, Mich	Feb. 1, 1859.
Cultivators	James Dundas	Big Rock, Ill	Feb. 8, 1859.
Churn	Rufus Lapham and Riley P. Wilson	New York, N. Y	Feb. 8, 1859.
Cultivators	George Essington	Plainfield, Ill	Feb. 8, 1859.
Corn-shellers	Jeremiah P. Smith	Hummelstown, Pa	Feb. 8, 1859.
Cheese, manufacture of	F. A. Redington and George McCluer	Fredonia, N. Y	Feb. 8, 1859.
Corn-huskers	William N. Rowe	Sharpsburg, Md	Feb. 8, 1859.
Cultivator-teeth	William P. and Thomas H. Ford	Concord, N. H	Feb. 15, 1859.

Churn	John U. Fiester	Winchester, Ohio	Feb. 15, 1859.
Churn	Orren Stoddard	Busti, N. Y	Feb. 15, 1859.
Churn	Andrew Patterson	Birmingham, Pa	Mar. 1, 1859.
Cultivators	John W. Whitney	Bolton, Mass	Mar. 1, 1859.
Churn	Jeremiah Mitchell	Gosport, N. Y	Mar. 8, 1859.
Cultivators	C. H. Dawson	Jacksonville, Ill	Mar. 8, 1859.
Churn	Loren J. Wicks	Racine, Wis	Mar. 8, 1859.
Cotton-scraper	John Henderson	Attila county, Miss	Mar. 8, 1859.
Cultivators	Theodore Heerman	Sumner, Tenn	Mar. 8, 1859.
Cultivators	Daniel and A. S. Markham and D. Eldrid	Monmouth, Ill	Mar. 8, 1859.
Corn-huskers	Herman A. Doster	Bethlehem, Pa	Mar. 22, 1859.
Cultivators	John Smalley	Bound Brook, N. J	Mar. 29, 1859.
Cultivators	Thomas A. Robertson	Washington, D. C	Mar. 29, 1859.
Churn	Gardner P. Hopkins	Cabot, Vt	Mar. 29, 1859.
Corn-shellers	Charles W. Carter, assignor to L. L. Bond and George Coatsworth	Westerville, Ind.	Mar. 29, 1859.
Cultivators	J. C. Stoddard	Worcester, Mass.	Mar. 29, 1859.
Clod-crushers	E. B. Way	Jerseyville, Ill	Mar. 29, 1859.
Corn-shellers, with fan or cutters, &c	William L Potter	Clifton Park, N. Y	April 5, 1829.
Churn	Edward L. Dorsey	Greenwood, Ind	April 12, 1859.
Corn-stalks, machine for cutting	Hezekiah Johnston, assignor to self and Richard Withers.	Collinsville, Ill	April 12, 1859.
Corn-shellers	William H. Hovey	Springfield, Mass	April 19, 1859.
Corn-shellers	James J. Johnston	Allegheny, Pa	April 19, 1859.
Cotton-scrapers	Patrick Sharkey	Brownsville, Miss	April 26, 1859.
Corn and cob cutter	Samuel B. Shinn	Philadelphia, Pa	May 3, 1859.
Churn	Leonard Westbrook	New York, N. Y	May 10, 1859.
Churn	James O. Merrill	Chichester, N. H	May 10, 1859.
Cultivators	Is. B. Palamontain	Tarboro', N. C	May 10, 1859.
Cultivators	Milton Alden	Auburn, N. Y	May 10, 1859.
Cultivators	William C. Doss	Lavaca, Tex	May 10, 1859.
Corn, machine for husking	Jacob Naeher	North Orange, N. J	May 17, 1859.
Cultivators	Oliver H. Dennis	Altona, Ill	May 17, 1859.
Cultivators	Asa Presten	Unionville, Ohio	May 17, 1859.
Cultivators, seeding	Nicholas Whitehall	Newtown ,Ind	May 17, 1859.
Churn	William Kelly	Hastings, Mich	May 24, 1859.
Cultivators	W. I. Wilson	Franklin, Ind	May 24, 1859.
Cultivators	I. W. and Leonard Batson	Clarksville, Md	May 24, 1859.
Cultivators	Reuben M. Melton	Criglersville, Va	May 31, 1859.
Cultivators	C. Eastburn	Fairfield, Ky	May 31, 1859.
Corn-crushers	T. B. Coursey	Frederica, Del	May 31, 1859.
Churn	Jacob Closs	Decatur	May 31, 1859.

Agricultural inventions or discoveries for 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Clover-hullers	Christian Reif	Hartleton, Pa	May 31, 1859.
Churn	W. H. McClintock	Frankfort, Ohio	May 31, 1859.
Churn	James Roy Parker	Sing Sing, N. Y	May 31, 1859.
Cultivators	John Young	Joliet, Ill	June 7, 1859.
Corn-huskers	J. C. Clapp	Seneca Falls, N. Y	June 7, 1859.
Cultivators	Joseph Thirlwell	Galesburg, Ill	June 14, 1859.
Cultivators	Azel Smith	Westfield, Ohio	June 14, 1859.
Churn	Patrick S. Delvin	Reading, Pa	June 14, 1859.
Cultivators	Franklin Veal	Helletsville, Tex	June 21, 1859.
Clover, machine for pulling	Nathaniel Eames	Hanover, Pa	June 21, 1859.
Cultivators	James Peeler	Tallahassee, Fla	June 21, 1859.
Cultivators	J. C. Stoddard	Worcester, Mass	June 21, 1859.
Cultivators	Henry Wells	Walnut Grove, Ill	June 21, 1859.
Corn-huskers	A. Siddall	Ransom, Mich.	June 28, 1859.
Cultivators, rotary	John Young	Joliet, Ill	June 28, 1859.
Cultivators, cotton	William I. Rivers	Sumter, S. C	June 28, 1859.
Cultivator-teeth	Gardiner Maynard	Ilion, N. Y	June 28, 1859.
Churn	Loren J. Wicks	Racine, Wis	July 5, 1859.
Clover-hullers	Anthony Overocker	McHenry, Ill	July 5, 1859.
Churn	Josiah Stubbs	Dublin, Ind	July 5, 1859.
Corn-huskers	S. N. Grogg	Shelburne Falls, Mass	July 5, 1859.
Cultivators	Philips Kribs	Jefferson Furnace, Pa	July 5, 1859.
Corn-huskers	George F. Shaw	Woburn, Mass.	July 12, 1859.
Churns	Lorenzo Lake, assignor to self and Wm. Patton	Middleburg, Pa	July 19, 1859.
Cultivators, rotary	Benjamin F. Field	Sheboygan Falls, Wis	July 19, 1859.
Churn	Alfred Guthrie, assignor to Wardell Guthrie	Chicago, Ill	July 26, 1859.
Churn-dashers	Parker Wineman	Loydsville, Ohio	July 26, 1859.
Churn	W. S. Hall	Quincy, Mass	Aug. 2, 1859.
Corn-huskers	Daniel C. Smith	Township of Tecumseh, Mich	Aug. 2, 1859.
Cultivators	Amsey Warren	Westport, Conn	Aug. 9, 1859.
Cultivators, cotton	George W. Beard	Canton, Miss	Aug. 9, 1859.
Cultivators	James Rue	Englishtown, N. J	Aug. 9, 1859.
Cultivators	Leonard Packard	Galesburg, Ill	Aug. 9, 1859.
Cultivators	Parley I. Freeland, assignor to V. R. David	Newark, Ill	Aug. 9, 1859.

Cultivators	Samuel Morry	Lebanon, Pa	Aug. 9, 1859.
Churn	John J. Lahaye, assignor to self and John Tucker	Reading, Pa	Aug. 16, 1859.
Clover-bolts	Edward K. Collins	Chili, N. Y	Aug. 16, 1859.
Churn	S. S. Langdon	Cleveland, Ohio	Aug. 16, 1859.
Churn	E. L. Pratt, assignor to self and R. B. Titts	Philadelphia, Pa	Aug. 30, 1859.
Churn	A. L. Sperry	Auburn, Ind	Aug. 30, 1859.
Cotton-scrapers	Jonathan H. Mitchell	Germantown, Tenn	Sept. 13, 1859.
Churn	C. L. Gilpatrick	Saco, Me	Sept. 13, 1859.
Cultivators	J. H. Frampton	Hopewell, Ohio	Sept. 13, 1859.
Churn	William Campbell	Waterloo, Pa	Sept. 13, 1859.
Churn	Malachi B. Hossler	Columbia City, Ind	Sept. 13, 1859.
Churn	James Taylor	Rushville, Ill	Sept. 13, 1859.
Churn-dash	Daniel K. France	Congress, Ohio	Sept. 13, 1859.
Cultivators	W. D. Johnson	Raleigh, N. C	Sept. 13, 1859.
Cultivators	Edmund and Benjamin Miller	Rising Sun, Ind	Sept. 13, 1859.
Cultivators	Asa M. Keith	Kosciusko, Miss	Sept. 13, 1859.
Churn	Samuel Gissinger	Allegheny, Pa	Sept. 20, 1859.
Churn	Abel Austin	Altona, Ill	Sept. 20, 1859.
Cheese-vats	O. Sage	Wellington, Ohio	Oct. 4, 1859.
Corn-shellers	George W. Tolhurst	Liverpool, Ohio	Oct. 4, 1859.
Cultivators	William Seely	Chillicothe, Ill	Oct. 11, 1859.
Cultivators	B. S. Morgan	Delhi, Iowa	Oct. 11, 1859.
Churn	S. N. Campbell	Elgin, Ill	Oct. 18, 1859.
Cultivators	Thomas McQuiston	Morning Sun, Ohio	Oct. 18, 1859.
Churn-dasher	Alfred Rose	Penn Yan, N. Y	Oct. 25, 1859.
Churn	E. N. Sprinkle	Marion, Va	Nov. 1, 1859.
Churn-dasher	N. B. Cooper	Gratis, Ohio	Nov. 8, 1859.
Cotton and corn-stalks, machines for pulling and cutting.	Horatio F. Hicks	Grand View, Ind	Nov. 8, 1859.
Corn-shellers	Nelson Burr	Batavia, Ill	Nov. 8, 1859.
Cotton-scrapers	Miles Earnhart	Cold Water, Miss	Nov. 15, 1859.
Cultivators	Isaac N. Pyle	Decatur, Ind	Nov. 15, 1859.
Churn	Ph. L. Clow	Cohoes, N. Y	Nov. 15, 1859.
Churn, rotary	Aaron. L. Cornell	New York, N. Y	Oct. 15, 1859.
Churn	Thomas A. Jebb	Buffalo, N. Y	Oct. 15, 1859.
Churn-dasher	Gillett Bunting, assignor to self and W. M. Jarrell	Liberty, Ind	Oct. 22, 1859.
Cheese-vats	C. M. Wilkins	Madison, Ohio	Oct. 22, 1859.
Cultivators	J. Whiteside and H. F. Crabell	Fuller's Corners, Ind	Oct. 22, 1859.
Cultivator-teeth	Henry Sanders	Utica, N. Y	Oct. 29, 1859.
Cotton pickers' wallets	G. H. Peabody	Columbus, Ga	Oct. 29, 1859.
Cleaning animals, machine for	Calvin D. Wheeler	New York, N. Y.	Dec. 6, 1859.
Churn	Henry Rohrer	Lancaster county, Pa.	Dec. 6, 1859.

Agricultural inventions or discoveries for 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Corn-cribs	A. B. Turbee	Dresden, Ohio	Dec. 6, 1859.
Cotton-seed hullers	Charles A. Lowber	Medina, N. Y	Dec. 6, 1859.
Clover-seed, machine for bolting, &c	John C. Birdsell	West Henrietta, N. Y	Dec. 13, 1859.
Churn	Mortimer S. Hardha, assignor to self, Rufus S. Sanborn, and H. B. Jones.	Sycamore, Ill	Dec. 13, 1859.
Corn-shellers	B. Bridendolph	Clear Spring, Md	Dec. 20, 1859.
Cultivators, seeding	Samuel D. Tracy	Vernon, Ohio	Dec. 27, 1859.
Cultivators	Henry Gilliard	Mount Hope, Wis	Dec. 27, 1859.
Cultivators	Morgan L. Rogers	Spring, Pa	Dec. 27, 1859.
Cultivators, cotton	John R. King	Raleigh, Tenn	Dec. 27, 1859.
Cultivators, cotton	Peter Monaghan	Camack, Ga	Dec. 27, 1859.
Drills, grain	James Ford	Wabash, Ind	April 12, 1859.
Drain-tile machine	John Daines	Birmingham, Mich	June 14, 1859.
Drills, seed	Stephen Burrows	Lima, Wis	Sept. 13, 1859.
Drills, manure	G. B. Singletary	Greenville, N. C	Dec. 13, 1859.
Flail-caps	Thomas J. Hubbard	Hamilton, N. Y	Jan. 11, 1859.
Fan, grain and corn-sheller	Ham'n E. Smith, assignor to self, D. B. Nelson, and John L. Myers.	Philadelphia, Pa	Jan. 18, 1859.
Fertilizers, machine for distributing	Z. N. Morrell	Cameron, Tex	Sept. 27, 1859.
Fertilizers	L. Harper	Riceville, N. J	Nov. 8, 1859.
Fertilizers	I. I. Mapes	Newark, N. J	Nov. 22, 1859.
Fans, grain	Oliver Lindsay and Robert F. Strean	Washington, D. C	Nov. 29, 1859.
Fertilizers	Wm. D. Hall, assignor to Quinnepeoc & Co	Hamden, Conn	Dec. 20, 1859.
Fertilizers	I. I. Mapes	Newark, N. J	Dec. 20, 1859.
Guano and other fertilizers, machine for sowing	John H. Leach	Oakville, Md	Jan. 4, 1859.
Grain into gavels, devices for gathering	William M. Waggoner	Middletown, Ind	Jan. 18, 1859.
Grain-cleaning machines	Wallace & Mellon	North Sewickley post office, Pa.	Mar. 8, 1859.
Grain-separators	Franklin I. May	Beverly, N. J	July 19, 1859.
Grain-shovels	David B. Rogers	Pittsburg, Pa	May 10, 1859.
Grain-bins	D. D. Badger and William S. Sampson, assignors to D. D. Badger.	New York, N. Y.	June 14, 1859.
Grain in bundles, machine for binding	James D. Osborn	Constantine, Mich	June 14, 1859.
Grain-cradles	Moses R. Flanders	Parishville, N. Y	June 28, 1859.
Grain, apparatus for drying	Joseph Suter	Chicago, Ill	June 28, 1859

Grain, machine for hulling and scouring	Joseph N. Treadwell	Reading, Pa	Mar 1, 1859.
Grain, machine for cutting and binding	Frederick Meyer	Napierville, Ill.,	Aug. 2, 1859.
Grain, machine for weighing	Charles H. Hunter	Shelbyville, Ind	Aug 23, 1859.
Grain, machine for weighing	John Van Hoone	Magnolia, Ill	Sept. 13, 1859.
Grain-binding machines	Allen Sherwood, assignor to E. P. Senter, A. H. Goss, William Hiles, and Ameretta Sherwood.	Auburn, N. Y	Aug. 30, 1859.
Grain-separators	J. L. Booth	Cuyahoga Falls, Ohio	Sept. 20, 1859.
Grain-binders	C. H. Durkee	Hartford, Wis.	Nov. 22, 1859.
Grinding apples	Alexander Dean	Jerusalem, N. Y	Mar. 15, 1859.
Grain, machine for cleaning	Harrison Fitts, assignor to himself and Nelson Turrell.	Somerset, Mich	April 12, 1859
Grain, machine for cleaning	Thomas C. Gleason	Rochester, N. Y	May 3, 1859.
Grain-hulling machines	William Zimmerman	Quincy, Ill	June 14, 1859.
Grain, machine for hulling and scouring	Thomas F. Waganer	Trenton, N. J	June 28, 1859.
Grain, apparatus for stirring and delivering	Sylvester Marsh	West Roxbury, Mass	Oct. 11, 1859.
Grain-cleaners	Isaac Waite	Watertown, N. J.	Oct. 11, 1859.
Grain-separators	H. Mongomery and Simeon Howes	Silver Creek, N. Y	Feb. 22, 1859.
Grain-separators	I. L. Booth	New York, N. Y.	Mar. 8, 1859.
Grain-separators	Jacob Benner	Allegheny City, Pa	April 12, 1859.
Grain-separators	James B. Crist	Evansville, Ind	May 10, 1859.
Grain-separators	James Vaughan	Magnolia, Ill	May 10, 1859.
Grain-separators, shoe for	Hiram Aldridge	Michigan City, Ind.	May 24, 1859.
Grain-separators	Austin Potter, assignor to self and Joel W. Norton	Williamson, N. Y	June 28, 1859.
Grain-separators	J. L. Booth	Cuyahoga Falls, Ohio	July 12 and Sept 20, 1859.
Grain-separators	Franklin I. May	Beverly, N. J	July 19, 1859.
Grain-separators	P. J. Aukney and Daniel J. McGreevey	New Lexington, Ohio	Sept. 20, 1859.
Grain-separators	Jeff'n Nash, assignor to self and Alonzo K. Cutts	Janesville, Wis	Sept. 27, 1859.
Grain-separators	Jacob Seebold	New Berlin, Pa	Oct. 4, 1859.
Grain-separators	F. Swift	Hudson, Mich	Oct. 25, 1859.
Grain-separators	P. Griswold and H. H. Seeley	Hudson, Mich	Nov. 22, 1859.
Grain-separators	Daniel Spencer	Cortlandt, N. Y	Nov. 22, 1859.
Grain-separators	D. S. Wagener	Penn Yan, N. Y	Nov. 29, 1859.
Grain-separators	William Wilmington	Toledo, Ohio	Nov. 29, 1859.
Grain-separators	John R. Moffitt	Piqua, Ohio	Nov. 29, 1859.
Gins, cotton	Edward Gotthiel	Galveston, Tex	April 19, 1859.
Ginning cotton, machine for burring wool and	F. A. Calvert and Charles G. Sargent	Lowell, Mass	June 7, 1859.
Gin-sharpener, cotton	A. H. Burdine	Chulahoma, Miss	July 19, 1859.
Gins, cotton	Wm. F. Pratt, assignor to E. Carver & Co	East Bridgewater, Mass	Aug. 30, 1859.
Gin, cotton	John Wilson	Anderson C. H., S. C	Sept. 27, 1859.
Gins, cotton	P. E. Collins	Mobile, Ala	Oct. 4, 1859.
Gins, cotton	Enoch Osgood	Boston, Mass	Oct. 18, 1859.

Agricultural inventions or discoveries for 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Gins, cotton	Benjamin G. Beadle	Memphis, Tenn	Nov. 1, 1859.
Gins, cotton	F. Wuterich and J. Koeber	New York, N. Y.	Nov. 8, 1859.
Gins, cotton	D. G. Olmstead	Vicksburg, Miss	Nov. 20, 1859.
Gins, cotton	W. McLendon	Greenville, Ga	Dec. 27, 1859.
Harvesters	A. C. Brownlick	Buffalo, N. Y	Jan. 4, 1859.
Harvesters, corn	R. C. Mauck	Conrad's Store, Va	Jan. 4, 1859.
Harrows, rotary	Charles Howell	Cleveland, Ohio	Jan. 4, 1859.
Harvesters, corn	Isaac Reamer	Conrad's Store, Va	Jan. 11, 1859.
Harrows, rotary	Mark W. House	Cleveland, Ohio	Jan. 18, 1859.
Harvesters	William H. Ketchum	Buffalo, N. Y	Jan. 18, 1859.
Harvesters	William N. and Andrew Whiteley	Springfield, Ohio	Jan. 18, 1859.
Harvesters	G. W. Richardson and Robert Glover, assignors to themselves, I. B. Williams, and William A. Horrale.	Grayville, Ill.	Jan. 25, 1859.
Harvesters	C. G. Dickinson	Poughkeepsie, N. Y	Feb. 1, 1859.
Harvesters	Sylvester Persons and Alfred M. Cone	Panama, N. Y	Feb. 1, 1859.
Harrows, rotary	W. T. Hildrup	Harrisburg, Pa.	Feb. 1, 1859.
Harvesters	George E. Chenoweth	Baltimore, Md	Feb. 8, 1859.
Harvesters	William K. Miller	Canton, Ohio	Feb. 8, 1859.
Harvesters	M. G. Hubbard	Penn Yan, N. Y	Feb. 15, 1859.
Harvesters	Daniel Clow	Janesville, Wis	Feb. 15, 1859.
Harvesters	B. F. Ray	Baltimore, Md	Feb. 15, 1859.
Harvesters	M. G. Hubbard	Penn Yan, N. Y	Feb. 22, 1859.
Harvesters	Walter A. Wood	Hoosick Falls, N. Y	Feb. 22, 1859.
Harvesters	Daniel Ranck	Intercourse, Pa	Mar 1, 1859
Harvesters	George E. Chenoweth	Baltimore, Md.	Mar. 1, 1859.
Harvesters	Charles Brownlich	Buffalo, N. K	Mar 1, 1859.
Harvesters	David P. Kinyon	Raritan, N. J	Mar 1, 1859.
Harvesters	Russell Warner	Brattleboro', Vt	Mar 1, 1859.
Harvesters, corn	J. L. Chapman	Kiumundy, Ill	Mar 1, 1859.
Harvesters, cotton	John Griffin	Louisville, Ky	Mar 8, 1859.
Harvesters	Patterson & Colborn	Baltimore, Md	Mar 8, 1859.
Harvesters	Andred Ralston	West Middletown, Pa	Mar 8, 1859.
Harvesters, corn	Jos. H. Kita	Conrad's Store, Va	Mar 8, 1859.

Harvesters	J. A. Moore and A. H. Patch	Louisville, Ky	Mar. 29, 1859.
Hay-mangers	John Packer	Philadelphia, Pa	Mar. 29, 1859.
Hop-frames	Thomas D. Aylesworth	Ilion, N. Y	Mar. 29, 1859.
Hop-frames	Henry R. Keese	Bridport, Vt	Mar. 29, 1859.
Hop-frames	Is. S. and Henry R. Russell	New Market, Md	Mar. 29, 1859.
Hop-frames	Samuel W. Tyler	Greenwich, N. Y	Mar. 29, 1859.
Harvesting-machines	William and John Webber	Rockton, Ill	Mar. 29, 1859.
Harvesters	W. S. Stetson	Baltimore, Md	April 5, 1859.
Harvesters	Gilderoy Lord	Watertown, N. Y	April 12, 1859.
Harvesters	Hiram H. Scoville	Syracuse, N. Y	April 12, 1859.
Harvesters	John Smalley	Bound Brook, N. J	April 12, 1859.
Harvesters	Levi H. Colborn	Baltimore, Md	April 12, 1859.
Harrow, rotary	S. M. Wade	Andover, Ohio	April 12, 1859.
Harrow, rotary	W. T. Hildrup	Harrisburg, Pa	April 12, 1859.
Harvesting-machines	George Esterly	White Water, Wis	April 19, 1859.
Harvesting-machines	Samuel Ray and Moses R. Shalters	Alliance, Ohio	April 19, 1859.
Harvesters	I. V. A. Wemple	Chicago, Ill	April 19, 1859.
Harvesting-machines	George and William Chamberlin	Olean, N. Y	April 26, 1859.
Harvesters, corn	Is. Reamer and Henry Miller	Conrad's Store, Va	April 26, 1859.
Harvesting-machines	W. A. Wood	Hoosick Falls, N. Y	May 3, 1859.
Harvesting-machines	Henry Marcellus	Amsterdam, N. Y	May 3, 1859.
Harvesting-machines	Josiah D. Smith	Lancaster, Ohio	May 3, 1859.
Harrows, rotary	George W. Tolleman	Augusta, Ga	May 10, 1859.
Harrows	J. H. French	Syracuse, N. Y	May 10, 1859.
Harvesting-machines	Samuel Thomas	Burnett, Wis	May 10, 1859.
Hay, machine for loading	Samuel V. Essick	Moultrie, Ohio	May 10, 1859.
Harvesting-machines	H. Willard and Robert Ross	Vergennes, Vt	May 10, 1859.
Harvesting-machines	William H. Wilson	Denton, Md	May 10, 1859.
Harvesting-machines, raking-attachment for	George Tatlock	Salem, Ind	May 10, 1859.
Harvesting-machines	M. G. Hubbard	Penn Yan, N. Y	May 10, 1859.
Harvesting-machnies	W. S. Stetson	Baltimore, Md	May 17, 1859.
Harvesting-machines	W. S. Stetson and R. F. Maynard	Baltimore, Md	May 17, 1859.
Harvesting-machines	Jesse Little	Chambersburg, Pa	May 24, 1859.
Harvesting-machines	Jesse Whitehead	Manchester, Va	May 24, 1859.
Harvesting-machines	Cor. R. Brinckerhoff	Batavia, N. Y	May 24, 1859.
Harvesters, sugar-cane	Robert R. Taylor	Reading, Pa	May 24, 1859.
Harrows	Robert W. Buckles	Grayville, Ill	May 24, 1859.
Harvesting-machines	John McPherson	Pennington, N. J	May 31, 1859.
Harrows, rotary	I. W. McLean	Lebanon, Ind	June 7, 1859.
Harrows	J. Herald and C. B. Tompkins	Trumansburgh, N. Y	June 7, 1859.
Harvesting-machines	H. H. Luther	Warren, R. I	June 7, 1859.

Agricultural inventions or discoveries for 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Harvesters, corn	G. W. Richardson and James W. White, assignors to themselves and George W. Weed.	Grayville, Ill	June 14, 1859.
Hay, machines for making	Thomas J. Goff	Warren, R. I	June 14, 1859.
Harvesting beans, machine for	S. V. R. Newman	Covington, N. Y.	June 21, 1859.
Harvesters, corn and cane	H. D. McGeorge and D. S. Greer	Morgantown, Va	June 21, 1859.
Harvesting-machines	William and Thomas Schnebley	Hackensack, N. J	June 21, 1859.
Harvesters, guard-fingers for	A. A. Hotchkiss and I. P. Andriance	Sharon, &c., Conn., &c	June 21, 1859.
Harvesting-machines	William and Thomas Schnebley	Hackensack, N. J	June 21, 1859.
Harvesting-machines	A. G. Stipher	Richmond, Ind.	June 28, 1859.
Harvesters, raking-attachment for	C. P. Gronberg	Montgomery, Ill	June 28, 1859.
Hay, machine for making	J. C. Stoddard	Worcester, Mass	June 28, 1859.
Harrows, rotary	Christopher and J. K. Gingrich	Annville, Pa	June 28, 1859.
Harvesting-machines	McClintoch Young, jr	Frederick, Md	June 28, 1859.
Harvesting-machines	Benjamin G. Fitzhugh	Frederick, Md	June 28, 1859.
Harvesting-machines	Thomas B. Butler	Norwalk, Conn	July 5, 1859.
Harvesters	Lewis and Jacob Miller, assignors to C. Aultman & Co.	Canton, Ohio	July 5, 1859.
Harvesters, cotton	Lewis Bishop	Talladega, Ala	July 5, 1859.
Harvesting-machines	George W. Richardson, assignor to self and Geo. M. Weed.	Grayville, Ill	July 19, 1859.
Harvesters	Moses H. Gregg, assignor to self and Thomas N. Page.	South Boston, Mass	July 19, 1859.
Harvesters	Heman Carter	Green, N. Y.	July 19, 1859.
Harvesters	C. B. and G. B. Garlinghouse	Allensville, Ind	July 19, 1859.
Harvesters	W. A. Wood and J. M. Rosebrooks	Hoosick Falls, N. Y	July 19, 1859.
Harvesters	Henry Fisher	Alliance, Ohio	July 26, 1859.
Harvesters	Samuel A. Purse	Ashley, Mo	July 26, 1859.
Harvesters	Obed H. King	Salem, Iowa	Aug. 2, 1859.
Harvesters	Stephen A. Lindsay	Unionville, Md	Aug. 2, 1859.
Harvesters, sickle-guards for	Andrew Shogren	Chicago, Ill	Aug. 2, 1859.
Harvesters, corn	W. Cogswell and C. A. Mathewson	Ottawa, Ill	Aug. 9, 1859.
Harvesters, corn	B. T. Currier	Bath, Me	Aug. 9, 1859.
Harvesters, binding-apparatus for	Charles H. McAleer	Chambersburg, Pa	Aug. 16, 1859.
Harvesters	I. S. and R. Hawkins	Greenfield, Ind	Aug. 23, 1859

Harvesters	Obed Hussey	Baltimore, Md.	Aug. 23, 1859.
Harvesters	J. A. Falk, A. Johnson, and G. A. Erickson	Altona, Ill.	Aug. 30, 1859.
Harvesters	Abner Whiteley	Springfield, Ohio	Aug. 30, 1859.
Harrows, rotary	William P. Goolman, assignor to self, S. B. Morris, and W. Hollingsworth.	Dublin, Ind.	Aug. 30, 1859.
Harvesting-machines	G. W. Richardson and R. Glover, assignors to themselves, J. B. Williams, and W. A. Howel.	Grayville, Ill	Sept. 6, 1859.
Harvesters, cutting-apparatus of	Thomas D. Aylesworth	Ilion, N. Y.	Sept. 6, 1859.
Harrows, rotary	George Cook	Paris, Ill.	Sept. 13, 1859.
Harvesting-machine	A. H. Inskeep	Middlebury, Ohio	Sept. 13, 1859.
Harvesters, reels for	George S. Curtis	Chicago, Ill.	Sept. 27, 1859.
Harvesters	Tobias Crumling	Hellam, Pa	Sept. 27, 1859.
Harvesters	I. D. Custer	Norristown, Pa.	Sept. 27, 1859.
Harvesters	David Zug	Shaefferstown, Pa	Oct 4, 1859.
Harrows, rotary	Martin C. Gilgore	Washington, Iowa	Oct 4, 1859.
Hoes, weeding	H. H. Baker	New Market, N. J.	Oct 4, 1859.
Harvesters, corn	Waldren Beach, assignor to self and John L. Reese, jr.	Baltimore, Md.	Oct 4, 1859.
Harrows, rotary	O. D. Barrett	Cleveland, Ohio	Oct 4, 1859.
Harvesters, dividers for	J. H. Shireman	East Berlin, Pa	Oct 4, 1859.
Harvesters	Henry B. Ramsay	Indianapolis, Ind	Oct 11, 1859.
Harvesters	James McAleer.	Chambersburg, Pa	Oct. 11, 1859.
Harrows, rotary	Sidney S. Hoyle	Cleveland, O	Oct. 11, 1859.
Hoes, weeding	James M. Adams, assignor to self and Alonzo Johnson	Canton, Mass.	Oct. 18, 1859.
Harvesters	E. Ball	Canton, Ohio	Oct. 18, 1859.
Harrows	Samuel H. Hamsher	Decatur, Ill	Oct. 18, 1859.
Harvesters	John Ebner and F. Lenthy	Lancaster, Pa.	Oct. 18, 1859.
Harvesters	Horace L. Emery	Albany, N. Y.	Oct. 25, 1859.
Harvesters	J. A. Dufield	McHenry, Ill	Nov 1, 1859.
Harvesters	W. A. Kirby	Buffalo, N. Y.	Nov 15, 1859.
Harvesters	John Butter, assignor to James A. Saxton	Buffalo, N. Y.	Nov 15, 1859.
Harvesters	M. G. Hubbard	Penn Yan, N. Y.	Nov 15, 1859.
Harvesters, potato	J. D. Otstot	Springfield, Ohio	Nov. 15, 1859.
Harvesters, potato	Jacob E. Hardenbergh	Fultonville, N. Y.	Nov. 15, 1859.
Harvesters	George E. Chenoweth	Baltimore, Md	Nov. 15, 1859.
Harrows, seeding	Arthur E. Jerome	Monroeville, Ohio	Nov. 15, 1859.
Harvesters	William Morrison	Carlisle, Pa	Nov. 22, 1859.
Hay, machine for raking and loading	J. A. Althouse, assignor to self and F. W. Lechtenberger.	Phillipstown, Ill.	Nov. 22, 1859.
Harrows	Oliver C. Green	Dublin, Ind	Nov 22, 1859.
Harrow-teeth	D. M. Cummings	Enfield, N. H.	Nov. 22, 1859.

Agricultural inventions or discoveries for 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Harvesters, cotton	John Griffin	Louisville, Ky.	Nov. 22, 1859.
Harvesters	John P. Burnham	Rockford, Ill	Nov. 29, 1859.
Harvesters	William Cogswell and Ira Cogswell, jr.	Ottawa, Ill	Dec. 6, 1859.
Harvesters	D. Sanford	Taylor, Ill.	Dec. 6, 1859.
Hay-making machines	J. C. Stoddard	Worcester, Mass.	Dec. 6, 1859.
Harvesters	L. G. Kniffen	North Salem, N. Y	Dec. 13, 1859.
Harvesters	John Gore	Brattleboro', Vt	Dec. 27, 1859.
Harvesters	Jesse Jacobs	———, Greene co., Ohio	Dec. 27, 1859.
Harvesters	Samuel N. Purse	Ashley, Mo	Dec. 27, 1859.
Mowing-machines	Thomas Windall, assignor to J. B. Ford, James H. Shields, and H. L. Bridwell.	New Albany, Ind	Jan. 11, 1859.
Mowing-machines	Walter A. Wood	Hoosick Falls, N. Y	Feb. 22, 1859.
Mowing-machines	Obed Hussey	Baltimore, Md	July 5, 1859.
Milking cows, machine for	Samuel W. Lowe	Philadelphia, Pa	Aug. 9, 1859.
Milking cows, machine for,	John W. Kingman	Dover, N. H	Aug. 9, 1859.
Mowing-machines	Thomas H. Dodge	Washington, D. C	Nov. 15, 1859.
Mills, sugar-cane	William T. Dennis	Richmond, Ind	Jan. 25, 1859.
Meal and flour, machine for making	George W. Holman	Beloit, Wis	Feb. 1, 1859.
Mill for grinding grain	William H. Hope	Washington city, D. C.	Feb. 1, 1859.
Mill for grinding cane, &c	Is. A. Hedges	Cincinnati, Ohio	Feb. 1, 1859.
Mill, corn and cob	John De Frain, assignor to W. Callahan and W. Grant.	Philadelphia, Pa	Feb. 15, 1859
Mills, sugar-cane	A. Van Trump	Lancaster, Ohio	Mar. 1, 1859.
Mills, sugar	Ralph Emerson, jr	Rockford, Ill	Mar. 15, 1859
Mills, sugar	Thomas E. Hunt, assignor to self and Nathan T. Hunt.	Indianapolis, Ind.	Mar. 15, 1859.
Mills for grinding, crushing, &c	Philander Perry	Troy, N. Y	April 19, 1859
Mill, cob and grain	John R. Marston	New York, N. Y	April 19, 1859.
Mills, sugar	John L. Brown and A. C. Greenleaf	Indianapolis, Ind.	April 26, 1859.
Mills, cider	Joseph Rosenkans	Avoca, N. Y	May 3, 1859.
Mills, corn and cob	William Sailor, assignor to self and William L. and H. R. Boyer.	Philadelphia, Pa	May 17, 1859.
Mills, corn	Joshua W. Taylor	Philadelphia, Pa	May 31, 1859.
Mills, sugar	John Burge	Terre Haute, Ind	June 21, 1859.

Mills, sugar	James W. Chapman	Trinity Springs, Ind	June 21, 1859.
Mills, sugar	Josiah R. Gates, assignor to self, J. J. Dumont, and E. T. Sinker.	Indianapolis, Ind.	July 5, 1859
Mills for crushing-cane	H. E. Emery	Lincoln, Ohio	July 5, 1859.
Mills, sugar	John Paynter, assignor to self and John McCorkle.	Shelbyville, Ind	July 12, 1859.
Mills for crushing sugar-cane	Daniel Bassett	White Water, Wis.	Aug. 2, 1859.
Mills, hominy	George Strause	Boonsboro', Md	Sept 20, 1859.
Mills for crushing sugar-cane	F. M. Robinson	Conneautville, Pa	Oct. 25, 1859.
Mills, cider	A. D. Hoffman	Belleville, Mich	Nov. 8, 1859.
Manure, artificial	Duncan Bruce	Paspebrie, Canada	Jan. 11, 1859.
Planters, seed	Joel Bryant	Brooklyn, N. Y	Jan. 4, 1859.
Potato-diggers	R. L. Allen	New York, N. Y	Jan. 18, 1859.
Planters, seed	J. F. Beckwith and A. G. Gage	South Alabama, N. Y	Jan. 18, 1859.
Plows	G. D. Colton	Galesburg, Ill	Jan. 18, 1859.
Planters, corn	John L. Hoag	Genoa, Ill	Jan. 18, 1859.
Planters, corn	James Hughes and Nathan Stonecipher	Cambridge City, Ind	Jan. 18, 1859.
Plow, steam	Samuel K. Bassett	Galesburg, Ill	Feb. 8, 1859.
Plow, beans	John S. Hall	Manchester, Pa	Feb. 22, 1859.
Plow	John M. Hall	Warrenton, Ga	Feb. 22, 1859.
Planters, corn	Amos G. and Andrew J. Thompson	Bellville, Ohio	Mar. 1, 1859.
Plows	Is. Rulofson	Penn Yan, N. Y	Mar. 1, 1859.
Potato-diggers	Robert Niven	Gates, N. Y	Mar. 1, 1859.
Planters, seed	John C. Baker	Mechanicsburg, Ohio	Mar. 1, 1859.
Planters, seed	J. C. Benthall	Oakland, Tex	Mar. 1, 1859.
Plows	John M. Whitney	Bolton, Mass	Mar. 1, 1859.
Plows	Sol. Williams, jr	Hume, N. Y	Mar. 8, 1859.
Planters, cotton-seed	Charles C. Garrett	Spring Hill, Ala	Mar. 8, 1859.
Planters, seed	George Watt	Richmond, Va	Mar. 8, 1859.
Planters, corn	Stephen Elliott	Washington, Ind	Mar. 15, 1859.
Planters, corn	John G. Mitchell	Collington, Md	Mar. 29, 1859.
Plows	William J. Griffies	Marrietta, Ga	Mar. 29, 1859.
Planters, corn	Jacob Haynes	Cameron, Ill.	Mar. 29, 1859.
Planters, seed	Daniel R. Prindle	Bethany, N. Y	Mar. 29, 1859.
Potatoes, digging, machine for	J. C. Stoddard	Worcester, Mass	Mar. 29, 1859.
Plows	W. H. Wilson	Summerfield, Ohio	April 12, 1859.
Plows	W. C. Holmes	Barnersville, Ga	April 12, 1859.
Planters, cotton-seed	J. P. Crutcher	Silver Spring, Tenn	April 12, 1859.
Plows, and locomotive machine for propelling	Warren P. Miller	Maysville, Cal	May 3, 1859.
Planters, seed	David M. Smith	Springfield, Vt	May 10, 1859.
Planters, corn	R. B. Gilbert	Sutherland Springs, Tex	May 10, 1859.
Plows	Williamson Nichols	Yarboro', Ga	May 10, 1859.
Planters, seed	D. S. Fisher	Mauckport, Ind	May 10, 1859.

Agricultural inventions or discoveries for 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Planters, corn	A. W. Brinkerhoff	Upper Sandusky, Ohio	May 10, 1859.
Planters, corn	L. F. Bingham and O. Pierce	Chicago, Ill	May 10, 1859.
Planters, corn	Samuel E. Hartwell	New York, N. Y	May 10, 1859.
Plows	James C. Moltrup	Bucyrus, Ohio	May 10, 1859.
Potatoes, machine for digging and gathering	Jonathan B. Parvin, assignor to self and Elias Stratton.	Hightstown, N. J	May 10, 1859.
Plows, hill-side	Edward Van Camp	Readington, N. J.	May 10, 1859.
Plows	T. J. De Yampert	Shohola, Pa	May 10, 1859.
Planters, corn	Wm. H. King, assignor to self and Nelson Colson	Charleston, Ill	May 10, 1859.
Plows	C. M. Bryan	Wright City, Mo	May 10, 1859.
Plant-protectors	Eli Mosher	Flushing, Mich	May 10, 1859.
Plows	Edward Davidson	Batesville, Ark	May 10, 1859.
Planters, potato	J. C. Stoddard	Worcester, Mass	May 17, 1859.
Planters, seed	Joseph McKown	Geardstown, Va	May 24, 1859.
Plow-handles, method of forming	George W. Matthews	York, Pa	May 24, 1859.
Planters, seed	S. L. Stockstill	Medway, Ohio	May 24, 1859.
Planters, seed	C. F. Anderson	Charlestown, N. H	May 31, 1859.
Plows	Eli Moore	Slabtown, S. C.	June 14, 1859.
Plows, devices for securing the clevis to	R. B. Prindle	Coventry, N. Y	June 14, 1859.
Potatoes, machine for digging	George S. Tiffany	Palmyra, Mich	June 21, 1859.
Planters, corn	P. H. Freylinghousen and J. G. Heilman	Jonestown, Pa	June 21, 1859.
Potato-diggers	Perry Marcy	Tunkhannock, Pa	June 21, 1859.
Planters, corn	C. G. Udell	Morris, Ill	June 28, 1859.
Plows	L. E. Burdin	Paris, Ky	June 28, 1859.
Planters, seed	Giles Cramton	Marshall, Mich	June 28, 1859.
Planters, corn	Alexander, William, and James Campbell	Harrison, Ohio	June 28, 1859.
Planting cotton-seed, machine for	Z. A. Morrell	Cameron, Tex	July 5, 1859.
Planters, corn	Peter Platter, assignor to self and James S. Flemming.	Moore's Hill, Ind	July 5, 1859.
Plows	Isaac Cook and John T. Bever	Haynesville, Mo.	July 5, 1859.
Planters, corn	Henry Wiley	Frankfort, Ohio	July 5, 1859.
Planters, corn	J. W. West	Hillsborough, Ohio	July 5, 1859.
Pea-vines, devices for training	John T. Bever	Haynesville, Mo.	July 12, 1859.
Plow-handles, bending	John G. Ernst, assignor to H. R. Slaymaker	York, Pa	Aug. 2, 1859.

Potato-diggers	Leonard B. Griswold	Pennfield, N. Y	Aug. 9, 1859.
Planters, seed	W. D. Harrah and B. S. Baldwin	Davenport, Iowa	Aug. 9, 1859.
Planters, corn	Mathew Mitchell	Altona, Ill.	Aug. 9, 1859.
Planters, corn	James P. Coonley	Farmington, Mich.	Aug. 9, 1859.
Planters, cotton-seed	Elijah P. Beauchamp	Webster county, Ga	Aug. 9, 1859.
Planters, corn	Lawson G. Peel	Preston, Ga	Aug. 9, 1859.
Planters, seed	J. B. McMillan	Tipton, Ind	Aug. 9, 1859.
Planters, seed	Theodore B. Rogers	Wetherfield, Conn	Aug. 9, 1859.
Planters, seed	Walter Clark	Palmyra, Ill	Aug. 9, 1859.
Planters, cotton-seed	John W. Huntley	Lane's Creek, N. C	Aug. 16, 1859.
Planters, seed	Willis G. Murphy	Sequin, Tex	Aug. 16, 1859.
Planters, corn	Charles Whittaker	Davenport, Iowa	Sept. 13, 1859.
Plows	William B. Williams	Warrenton, N. C.	Sept. 13, 1859.
Planters, cotton-seed	T. T. and H. W. S. Collier	Lavernia, Tex	Sept. 13, 1859.
Planters, seed	Z. B. Brown and M. C. Godard	Granby, Ct	Sept. 13, 1859.
Planters, cotton-seed	P. M. Smith and T. T. Collier	Lavernia, Tex	Sept. 13, 1859.
Plows	William O'Neil	Pine Level, Ala	Sept. 13, 1859.
Planters, corn	William Morrison	Carlisle, Pa	Sept. 13, 1859.
Planters, corn	William Lees	Germantown, Ohio	Sept. 13, 1859.
Planters, seed	Levi L. Lancaster	Rocky Mount, N. C	Sept. 20, 1859.
Planters, seed	Swan Johan Wasterburg	Alton, Ill	Sept. 20, 1859.
Planters, seed	Lewis Reese Carpenter	Lancaster, Ohio	Sept. 27, 1859.
Planters, seed	John P. Allen	Midville, Ga	Oct. 4, 1859.
Planters, corn	Rufus M. Varner	Oxford, Miss	Oct. 4, 1859.
Planters, seed	W. H. Stuart	Millington, Md	Oct. 4, 1859.
Planters, corn	Christian Rapp	McLean county, Ill	Oct. 4, 1859.
Plows	E. D. and Z. W. Lee	Blakely, Ill	Oct. 4, 1859.
Planters, corn	J. C. Adams	Greensburg, Ind	Oct. 4, 1859.
Plows	Bold R. Hood	Clinton, N. C	Oct. 11, 1859.
Planters, seed	Andreas Maurer	New Carlisle, Ind.	Oct. 11, 1859.
Potato-digger	A. S. Capron and D. S. Davis	Grass Lake, Mich	Oct. 11, 1859.
Planters, corn	A. Kerlin	New Boston, Ill	Oct. 18, 1859.
Planters, seed	Adam Klaus	Belleville, Ill	Oct. 18, 1859.
Plow, steam	James Hawkins	Wilkins, Pa	Oct. 18, 1859.
Plows	Gilmore Emery and A. C. Wilson	Newfield, Me	Oct. 18, 1859.
Pruning-knives	Frank P. Goodall	Deering, N. H	Oct. 18, 1859.
Plows	David Eldred	Monmouth, Ill.	Oct. 18, 1859.
Plows, molding	Benjamin F. Avery	Louisville, Ky.	Oct. 25, 1859.
Planters, seed	George M. Evans	Pittsburg, Pa	Oct. 25, 1859.
Planters, corn	E. C. Allen	Le Roy, N. Y	Nov. 8, 1859.
Planters, corn	Oliver P. Moran	Haynesville, Mo.	Nov. 8, 1859.
Plows	J. P. Harris	Byhalia, Miss	Nov. 8, 1859.

Agricultural inventions or discoveries for 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Plows	W. T. Jones	Joliet, Ill	Nov. 15, 1859.
Plows	J. T. Townsend	Brenham, Tex	Nov. 15, 1859.
Plows, steam	A. E. and S. N. McGaughey	Wartedo, Minn	Nov. 29, 1859.
Plows	Simeon T. Peck	Penfield, Ga	Nov. 29, 1859.
Plows	A. A. Dickson	Anderson, S. C	Nov. 29, 1859.
Pitchforks	John Herald and C. B. Tompkins	Trumansburg, N. Y	Dec. 6, 1859.
Plows, steam	Jas. W. McLean, assignor to self and Edwin May.	Indianapolis, Ind	Dec. 6, 1859.
Plows	William F. Yeager	Starkville, Miss	Dec. 6, 1859.
Plows	Jackson Gorham	Bairdstown, Ga	Dec. 6, 1859.
Planters, seed	William H. North and Leonard Finlay	Canton, Mo	Dec. 13, 1859.
Planters, corn	O. C. McClure	Darby Creek, Ohio	Dec. 13, 1859.
Planters, seed	James H. Lee	Camanche, Iowa	Dec. 13, 1859.
Planters, cotton-seed	P. B. Baker	Wall Hill, Miss	Dec. 13, 1859.
Planters, seed	William Blessing	Jeffersonville, Ohio	Dec 13, 1859
Planters, seed	Henry Bell, assignor to Fenton H. Bogar and Jos. W. Tidball	Clinton, Ill	Dec 13, 1859
Plows, steam	J. W. Fawkes	Christiana, Pa	Dec 13, 1859.
Planters, seed	James T. Mercer	Calais, Ohio	Dec 27, 1859.
Planters, seed	George W. Roney	Baley's Mill, Fla	Dec. 27, 1859.
Plows	Charles Kesler and F. Reinhard	Columbus, Tex	Dec. 27, 1859.
Planters, cotton-seed	Rhodam M. Brooks	Meriwether county, Ga	Dec 27, 1859.
Plows	Samuel Walker	Kingston, Ga	Dec. 27, 1859.
Plows, gang	T. S. Heptinstall	Mendota, Ill	Dec 27, 1859.
Planters, cotton-seed	Rhodam M. Brooks	Greenville, Ga	Dec 27, 1859.
Rakes, horse	Wm. H. Brown	Middletown, N. Y	Jan 4, 1859.
Rakes, horse	B. Brindendolph, assignor to self and O. K. Bovery.	Clear Springs, Md	Jan 4, 1859.
Rakes, horse	Levi S. Deming	Newington, Conn	Jan 18, 1859.
Rakes, horse	Wm. H. Long	Lancaster, Pa	Mar 1, 1859.
Rakes, horse	F. C. Kneeland	Hartford, Conn	Mar. 1, 1859.
Rakes, horse	Wm. H. White	New Lisbon, N. Y	Mar 1, 1859.
Rakes, horse	I. C. Burget	Davenport Centre, N. Y	Mar. 8, 1859
Rakes, hay, machine for	David Ramler	Union Deposit, Pa	April 26, 1859.
Rakes, horse hay	George S. Reynolds	East Bethel, Vt	May 10, 1859.
Rakes horse	Elisha Geiger	Lancaster, Pa	May 24, 1859

Rollers, field	George Lindley	Chicago, Ill	May	31, 1859.
Rakes	Thomas Crane	Fort Atkinson, Wis	June	7, 1859.
Rakes, horse	Henry Hersh	Lancaster, Pa	June	14, 1859.
Rakes, horse	Philip Lebzelter	Lancaster, Pa	July	5, 1859.
Rakes, horse	Elijah Harris	Princeton, Ill	July	5, 1859.
Raking and loading hay, machines for	Grove Howard	Cardington, Ohio	July	19, 1859.
Rakes, horse	Maro Bradley	Dundee, Ill	Aug.	26, 1859.
Reaping-machines, automatic rakes for	B. G. Fitzhugh and W. C. Young, jr	Frederick, Md	Sep.	6, 1859.
Raking and loading hay, machines for	Thomas J. Wallace	Cameron, Ill	Sep	13, 1859.
Rakes, horse	Orris Pier	Ludlow, Vt	Sep.	13, 1859.
Rakes, horse	Theod. J. Steffe	Lancaster, Pa	Sep.	20, 1859.
Rakes, horse	Gideon Peirce	Ercildown, Pa	Nov.	29, 1859.
Rakes, horse hay	M. Reazer	Reading, Pa	Nov.	29, 1859.
Rakes, horse hay	Geo. N. Hall, assignor to self, S. Arthur, J. Pierce, and S. D. Arthur.	Mamakating, N. Y	Dec.	6, 1859.
Rakes, horse hay	Samuel Lessig	Reading, Pa	Dec.	27, 1859.
Spading-machines	George B. Field	St. Louis, Mo	Jan.	4, 1859.
Seeding-machines	W. G. Bulgin	West Jersey, Ill	Jan.	18, 1859.
Seeding-machines	John F. Seaman	Clyde, N. Y	Jan.	18, 1859.
Seeding-machines, arms of broadcast	Henry J. Hale	Indianapolis, Ind	Feb.	8, 1859.
Spading-machines, rotary	George W. B. Gedney	New York, N. Y	Feb.	8, 1859.
Seed-drills	Michael Boyer, assignor to Charles S. Rohrer and William Gunckel.	Germantown, Ohio	Feb.	8, 1859.
Straw and hay, machine for cutting	William O. Hickok	Harrisburg, Pa	Feb.	22, 1859.
Straw-cutters	Wm. Hinds, assignor to Jerome Hinds	Little Falls, N. Y	Feb.	22, 1859.
Seeding-machines	C. and D. Eggleston	Beloit, Wis	Mar.	1, 1859.
Shearing sheep	William F. Morgan	Rochester, N. Y	Mar.	8, 1859.
Seeding-machines	Daniel and A. S. Markham and D. Eldrid	Monmouth, Ill	Mar.	8, 1859.
Seeding-machines	E. O. Baxter, assignor to self, E. H. Riley, and W. T. Sweat.	Forreston, Ill	Mar.	8, 1859.
Scythe-snaths	S. B. Batchelor	Lowville, N. Y	Mar.	22, 1859.
Seeding-machines	Michael Simmons	Ira, Ill	Mar.	29, 1859.
Seeding-machines	F. M. Davis	Footville, Wis	Mar.	29, 1859.
Seeding-machines	A. R. Root, assignor to R. S. Rickey	Keokuk, Iowa	Mar.	29, 1859.
Seeding-machines	O. H. Melendy	Delhi, Iowa	April	5, 1859.
Seeding-machines	Moris D. Wells	Morgantown, Va	April	12, 1859.
Seeding-machines	John B. Duane	Schenectady, N. Y	April	12, 1859.
Seeding-machines	George W. Richardson, assignor to self and John P. Williams.	Grayville, Ill	April	26, 1859.
Seeding-machines	Stephen R. Hunter	Cortlandt, N. Y	April	26, 1859.
Spading-machines, steam	J. W. Goodell	East Wallingford, Vt	April	26, 1859.

Agricultural inventions or discoveries for 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Seed-drills	Charles Learned, assignor to self and George P. Stevens.	Indianapolis, Ind	May 10, 1859.
Sowing fertilizers, machines for	Elisha J. Burrall	Geneva, N. Y	May 10, 1859.
Straw-cutters	Stephen Elliott	Richmond, Ind	May 10, 1859.
Straw-cutter	John Bean and Benjamin Wright	Hudson, Mich	May 10, 1859.
Seeding-machines	Samuel Henry	Chenoa, Ill	May 10, 1859.
Seeding-machines	Thomas Short	Danville, Ill	May 17, 1859
Seeding-machines	Charles Messinger	Warren, Ohio	May 17, 1859.
Seeding-machines	E. O. Baxter	Forreston, Ill	May 17, 1859.
Straw-cutters	J. B. Drake	Goshen, Ind	May 17, 1859.
Straw-cutters	A. W. Fox	Athens, Pa	May 17, 1859.
Straw-cutters	George Roushe	Lima, Ohio	May 24, 1859.
Seeding-machines	Thomas H. Tatlow, jr	Palmyra, Mo	May 31, 1859.
Straw-cutters	Ensign Baker	Fredonia, N. Y	May 31, 1859.
Seeding-machines	Franklin Veal	Hallettsville, Texas	June 14, 1859.
Seeding-machines	Dl. Nichols, assignor to Charles and Edw'd Rumley	Onargo, Ill	June 14, 1859.
Sowing-machines	Solon P. Hubbell	Unadilla, N. Y	June 14, 1859.
Seeding-machines	Andrew Simmons	Nora, Ill	June 14, 1859.
Seeding-machines	Enos Stimson	Plainfield, Vt	June 14, 1859.
Sugar-cane, machine for cutting	Albert Philipp	Maysville, Wis	June 21, 1859.
Straw-cutters	Reuben Daniels	Woodstock, Vt	June 21, 1859.
Sowing fertilizers, machines for	James Peeler	Tallahasse, Fla	June 21, 1859.
Seeding-machines	Daniel Foreman, assignor to self, G. W. Sweringen and Jonathan Penoyer.	Navarre, Ohio	June 28, 1859.
Sowing fertilizers in drills, machines for	C. B. Davis	Lawrenceburg, Tenn	June 28, 1859.
Seeding-machines	Joshua C. Bean	Grayville, Ill	June 28, 1859
Seeding-plows	John S. Sinder	Lancaster, Ohio	Aug. 2, 1859.
Seeding-machines	E. McKinney	Montgomery, Ohio	Aug. 9, 1859
Sowing fertilizers, machines for	Lorenzo Tyler	Havana, N. Y	Aug. 9, 1859.
Seeding-machines	John Andrews	Clinton, Mass	Aug. 9, 1859.
Straw cutters	Sol. P. Smith	Crescent, N. Y	Aug. 9, 1859.
Seeding-machines	Jacob Maize	Wooster, Ohio.	Sep. 13, 1859.
Straw-cutters	Josh. B. Okev, assignor to self and Wm. H. Hendrick.	Indianapolis, Ind	Sep 13, 1859.

Seeding-machines	M. S. Tourtelett	Neshonoc, Wis	Sep. 13, 1859.
Seeding-machines	Hervy Sloan	Franklin, Ind	Sep. 13, 1859.
Straw-cutters	Andrew F. Blunk	Indianapolis, Ind	Sep. 13, 1859.
Seeding-machines	W. D. Johnson	Raleigh, N. C	Sep. 13, 1859.
Seeding-machines	S. G. Randall	New Braintree, Mass	Sep. 13, 1859.
Straw-cutters	Caspar Schultze and J. F. Schroder	Covington, Ky	Sep. 20, 1859.
Straw-cutters	A. D. Brown, assignor to Sallie D. Brown	Columbus, Ga	Oct. 4, 1859.
Straw-cutters	John S. Lash, assignor to self and Franklin Knauss.	Carlisle, Pa	Oct. 11, 1859.
Straw-cutters	Lucius Leavenworth	Trumansburg, N. Y	Oct. 11, 1859.
Straw-cutters	Harvey Trumbull	Central College, Ohio	Nov. 8, 1859.
Straw-cutters	Jacob H. Mumma	Harrisburg, Pa	Nov. 8, 1859.
Seeding-machines	A. N. Merrill	Batavia, Ill	Nov. 8, 1859.
Smoothing walks, &c., cylinders for	James Giles and C. B. Tompkins	Dryden, &c., N. Y	Nov. 15, 1859.
Scythe-rifles	Thomas J. Mayall	Roxbury, Mass	Nov. 22, 1859.
Seeding-machines	Oliver H. Dennis	Altona, Ill	Dec. 13, 1859.
Straw-cutters	Franklin B. Hunt, assignor to R. D. Von Deursan and J. B. Gibbs.	Cincinnati, Ohio	Dec 27, 1859.
Seeding-machines	Josiah W. Prentiss	Pultney, N. Y	Dec. 27, 1859.
Straw-cutters	Aaron E. James	Decatur, Ill	Dec. 27, 1859
Straw-cutters	W. H. Baker, Daniel Dean, and B. L. Fetherolf	Tamaqua, Pa	Dec. 27, 1859.
Seeding-machines	Worden P Penn	Belleville, Ill	Dec. 27, 1859.
Seed-drills	Worden P. Penn	Belleville, Ill	Dec. 27, 1859.
Seeding-machines	James Bonton	Macon City, Mo	Dec. 27, 1859.
Sugar, manufacture of	E. Pesier	France (French patent March 29, 1858.)	Jan. 11, 1859.
Sugar juice, apparatus for evaporating	Augs. Jouan	San Francisco, Cal	Jan. 25, 1859.
Starch, apparatus to manufacture	Wright Duryea	Glen Cove, N. Y	Feb. 1, 1859.
Saccharine juices, defecating and clarifying	John Spangenberg	New York, N. Y	Feb. 15, 1859.
Sugar juices, apparatus for evaporating	James Smart	Mansfield, Ohio	Mar. 15, 1859.
Sugar juices, defecating	A. H. Tail, assignor to George B. Hartson	New York, N. Y	June 28, 1859.
Sugar juices, defecating	M. H. Nicolas and L. J. Champagne	Thibodeaux, La	June 28, 1859.
Sugar, defecating	R. A. Stewart	Parish of St. Bernard, La	Aug. 2, 1859.
Sugar, steam-pans for clarifying	George M. Longacre	New Orleans	Sep. 6, 1859.
Sugar, refining	John Aspinall	Great Tower of London, Eng., (English patent February 8.)	Nov. 8, 1859.
Sugar juices, &c., clarifying and refining	Hermon P. G. Paulsen	Flatland, N. Y	Nov. 8, 1859.
Sugar juices, pans for evaporating	Wheeler Hedges, assignor to self and P. W. Gates.	Chicago, Ill	Nov. 29, 1859.
Sugar juices, apparatus for evaporating	Eugene Duchamp	St. Martinsville, La	Dec. 27, 1859.
Threshing-machines	J. B. Ford, A. Sullivan, and A. Gregg	New Albany, Ind	Jan. 25, 1859.
Threshing-machines	John A. Sigler, assignor to self and W. M. Giffiths & Co.	Martin's Ferry, Ohio	April 12, 1859.
Threshing-machines	J. R. Moffitt	Piqua, Ohio	May 24, 1859.

Agricultural inventions or discoveries for 1859.

Inventions or discoveries.	Inventors.	Residence.	Date of patent.
Threshing-machines	John J. Rollow, assignor to Charles C. Wellford	Fredericksburg, Va	July 5, 1859.
Threshing-machines	Josh. H. Siddall	Philadelphia, Pa	July 12, 1859.
Threshing-machines	Joshua Rollman	Sinking Springs, Pa	Sep. 20, 1859.
Threshing-machines	D. A. Willbanks	Harmony Grove, Ga	Dec. 6, 1859.
Trees, machine for girding and felling	A. P. Torrence	Oxford, Ga	Dec. 6, 1859.
Vegetable-cutters	J. Fraser	Rochester, N. Y	Jan 18, 1859.
Vegetable-cutters	W. C. Davol	Fall River, Mass	Feb. 22, 1859.
Vegetable-cutters	John Clary	Dayton, Ohio	July 19, 1859.
Vegetable-cutters	B. C. Hoyt	Port Washington, Wis	Oct. 4, 1859.
Vegetable-cutters	Andrew J. Chapman	Scipio, N. Y	Nov. 29, 1859.
Vegetable-slicer	Chauncey Parmelee	Wilmington, Vt	Dec. 13, 1859.
Yokes, ox	James D. Foster	Montgomery, Ala	Jan. 18, 1859.
Yokes, ox	Washington Burnham	Essex, Mass	May 24, 1859.
Yokes, ox	H. P. Judson	Bethlehem, Conn	Nov. 22, 1859.